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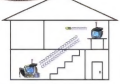

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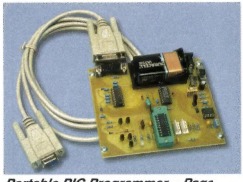

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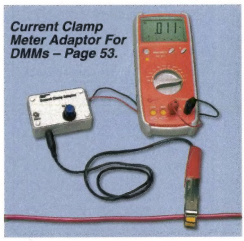

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PUBLISHER'S LETTER

Internet newsgroups can be a mixed blessing

These days probably 90 percent or more of our readers have access to email and the Internet and a majority use it very frequently. Indeed most of the letters to SILICON CHIP come via email, as a glance at our "Mailbag" and "Ask SILICON CHIP" pages will show.

Many readers also use the Internet to search for information on electronics but it is here that there are many pitfalls, with a vast amount of the posted information being misleading or simply wrong. In fact, it is often difficult to know whether the information you find is correct or not. In general, it is safe to regard information posted by electronics manufacturers on their own websites about their own products as being correct. Also, technical information on websites of university and other tertiary organisations and government bodies is also usually OK.

But apart from those, a vast amount of information posted by individuals and amateur organisations is highly suspect – definitely not to be trusted. This applies particularly to many electronic circuits and component applications published on the net and even more so where there might be a micro and some associated software. Often the software is "buggy" and the author or designer may have no interest or even the ability to correct what has been posted there for all to see.

This is a major dilemma for individuals searching for technical information – where do they go to have their questions answered? After all, there are very few magazines like SILICON CHIP anywhere else in the world.

So many people turn to technical newsgroups and potentially, they are a great solution. They can be a very useful forum where experienced electronics people can provide lots of helpful information to others. But again, how do you know whether the information being proffered is correct, merely someone's opinion or just plain wrong?

The situation is made worse when others come up on the newsgroup strongly disagreeing with previous information. And the disagreements are often not just a difference of opinion – often they degenerate into vitriolic abuse and sometimes even libel. I am thinking particularly here of two local newsgroups: aus.electronics and aus.hifi. A few individuals have become so disagreeable and abusive that they have made these sites quite unpleasant.

From our point of view, chaotic newsgroups are not at all helpful to the promulgation of electronics information. It discourages newcomers (and old-timers, for that matter) and leaves others seething with resentment.

In fact, some individuals on these newsgroups are so abusive that you wonder why anyone else would ever bother to offer useful information because of the risk of being abused. Which is a great shame because these abusive individuals often give advice which is technically correct but they destroy their goodwill and standing by being so unpleasant to anyone with the temerity to disagree.

So please, keep it civilised, people. Remember that newsgroups are there to help others in the very worthwhile pursuit of knowledge and fun in the field of electronics. If you can help someone asking a question, please do so. And if someone else offers contrary advice, correct it by referring them to some recognised sources. Ultimately, that approach will gain you far more respect and everybody who uses the site will find it much more helpful.

Leo Simpson

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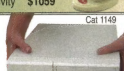
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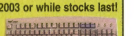

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MAILBAG

Halogen lamps are a UV hazard

I noted your dislike of halogen lamps in the Publisher's Letter in the June 2003 issue. Can I put a slightly different spin on the lamps and yet still come to the same conclusion? You were concerned about the 80% efficiency of the transformer. I think you will find if you check it out that the lamps are more efficient light producers than conventional lamps by more than enough to make the transformer/lamp combination more efficient than the conventional incandescent lamp.

They are more efficient light producers because they run the filament at a higher temperature. The amount of light produced in the visible spectrum increases very rapidly for only a modest increase in filament temperature, simply as a function the physics of radiation of hot bodies.

Low-voltage halogen lamps manage to be able to be run at these higher temperatures by a combination of three aspects of the lamp design without the resultant reduction in the lamp life. They run the envelope at a high pressure, they fill the envelope with halogen gas and they use a thicker filament wire. The high pressure and the halogen gas greatly reduce the evaporation of the tungsten while the thicker wire makes for a more robust filament structure. All three contribute to increase the lamp life and to counter the shortened life of the higher temperature.

To handle the very much-increased pressure, the glass must be made stronger. Now the stress in a cylindrical or spherical vessel is a function of the internal pressure and the ratio of the radius to the wall thickness. These lamps have both thicker walls and also smaller diameter envelopes. While this works stress-wise, the very small envelope gets very hot, being much closer to the filament. Ordinary sodium glass would soften and creep, leading to an aneurysm type failure so quartz glass is used.

And this is what upsets me about quartz halogen lamps. Because quartz glass is used, a significant amount of ultraviolet light is allowed to leave the lamp. Quartz unlike sodium glass is transparent to ultraviolet light. Besides the ultraviolet problem, I don't like the idea of a transformer in the roof space, hidden from view and able to possibly start a fire. I also don't like the fact there is or must be significant ventilation around the lamp assembly. After all, is not a ceiling a sealing?

Kenneth E. Moxham,
Urrbrae, SA.

Comment: we agree that halogen lights are more efficient than conventional incandescent lamps but their narrow beam means that they are impractical and inefficient in most domestic and commercial installations.

Linux articles appreciated

Thanks for the excellent series on Linux from November 2002 to February 2003. Even with only a minimal amount of previous Linux experience, I was able to follow exactly the steps described by John Bagster and make something very useful out of an ageing dinosaur.

Fortunately, I was able to dig up the distribution of Linux used in the article (Red Hat 7). I also happen to have the Optus flavour of cable and even live in the Brisbane area – it was as if the article was tailor-made to my situation.

Once again, thanks SILICON CHIP – any follow up articles on this subject would be greatly appreciated.

Dave Rogers,
via email.

Ferrite cores may be hard to get

The June 2003 issue of SILICON CHIP contained an interesting little SMPS and like most SMPS circuits, it uses a ferrite-cored inductor. The core type is described with a manufacturer's serial number and a supplier's catalog number. One day I might build the project. But when I do, it's very likely that the inductor core will no longer be available. The item will be superseded, no longer be manufactured or whatever. So that project will remain unbuilt and I will be disappointed.

I and many of your readers would be grateful if, when publishing articles using such ferrite inductor or transformer cores, you could give sufficient description of dimensions and magnetic properties so that we could get a roughly equivalent component.

Mike Newman,
via email.

Comment: we understand the problem but we really don't think that quoting all the characteristics (if we can get them) will necessarily solve the problem. By the way, we have given two sources for the powdered iron cores and they have been made for many years now. We do try and use components which will be available for years to come.

If you are really concerned about making the circuit in the future, why not purchase some cores now? The kit is available from Dick Smith Electronics, Jaycar and Altronics.

Specifications of PowerUp are misleading

The PowerUp project in the July 2003 has some anomalies with its power ratings. For someone who might pick the unit up, the only guide to its rating is the 10A label on the fuse; a natural assumption if you didn't build it and hadn't read the article.

The specifications in the article state the rating is 6A (set by S1)? The fuse should set the rating. The idea of having a fuse is to protect the other components - with a 10A fuse, the cable (7.5A), the switch (6A) and probably the PC board (about 5A by the chart I use) are not protected against overload. And with nothing on the label to indicate otherwise, the unit is likely

to be unwittingly used with loads of 8 or 9A.

Finally what is the purpose of the two 1.2MΩ VR25 resistors across the slave socket?

Andy Williamson,
via email.

Comment: we put the rating of 6A (1440W) in the article for the sake of completeness. Your objection can be met by either changing the fuse to 5A or the switch to 10A rating. Or omitting the power switch altogether. We understand that Jaycar are supplying their kit with a 10A switch.

The purpose of the VR25 resistors is to shunt most of the current which flows through the 1nF capacitor across the relay contacts when the PowerUp is off. Without these resistors, Neon2 would be fully alight all of the time.

Updating the PIC Programmer

I just read your latest review on updating the PIC Programmer, in the July 2003 issue of SILICON CHIP.

I had all sorts of grief with this unit under Windows 2000 and XP. However, in November 2002, the author, Nigel Goodwin, released a new version of the programming software which is called WinPicProgV1.91. **http://www.winpicprog.co.uk/**

This has an almost identical interface to the original and appears to work quite well. You still have to load the port driver but that's a "one-off".

I am running a 2.6GHz Athlon using Windows 2000 and XP Pro and it worked flawlessly under these. It also worked with Windows 2000 and 98SE on an old 650MHz machine. However, I am still going to try the new programs you listed, just for the hell of it.

Andrew Johansen,
via email.

Digital TV should be promoted

I do enjoy SILICON CHIP but have lately found Leo Simpson's near-Luddite editorials quite depressing. I'll save my feelings on low-voltage halogens for another time but how about being a little more encouraging on Digital TV? Isn't it an inevitability, like the move from analog to digital mobiles last decade?

Sure, it was forced upon us but what are you going to do? March on Alston's office? He does seem to be ill-informed on occasions but DTV is here now. And isn't the underlying reason for the change the more efficient use of the RF spectrum?

I accept most of what you say, apart from the reference to the networks' "low quality" digital service, and the uptake is at odds with Australians' usual rapid acceptance of new technology. But I believe you should be encouraging the system because it is inevitable and it is a superior format. Standard Definition is definitely NOT a "low-quality digital signal", except perhaps on paper.

Spend a week with wide-screen Standard Definition and you won't want to go back. I've lived with DTV for a few months and I love it. It is (subjectively) a superior image to analog and I do get a very good analog signal to compare with.

My young family enjoyed the extra ABC channels and more fool Alston for not helping the ABC financially on that score. Extra content does cost and that includes the "multi-view" concepts. They are possible but for now are just sales hype, as you implied.

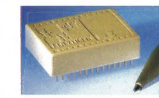
I'm not convinced that HD was really a necessary inclusion in the DTV spec; it's perhaps a little too esoteric but we shall see. I feel that the move to DTV is akin to the move from vinyl to CD (audiophile sensibilities aside) or VHS to DVD. I say "akin" not "the same as"; it's a question of degree.

I may be in the 1% you quote but I do have friends with DTV. Digital TVs are expensive, set-top boxes less so but still not something you buy on a whim. But rather than sitting around with your "circle of friends and acquaintances" making your dogmatic pronouncements on the "complete failure" of DTV with a supremely irritating "told-you-so" arrogance, how about promoting its benefits and encouraging it as a viable, and inevitable, alternative?

David McCarthy,
Crows Nest, NSW.

Comment: sorry you think Leo Simpson is a Luddite but it is better to air these aspects of technology rather than ignore them. On the positive side, set top boxes are dropping in price but you still need a set-top box for each set in your household and another to

The Tiger comes to Australia



The BASIC, Tiny and Economy Tigers are sold in Australia by JED, with W98/NT software and local single board systems.

Tigers are modules running true compiled multi-tasking BASIC in a 16/32 bit core, with typically 512K bytes of FLASH (program and data) memory and 32/128/512 K bytes of RAM. The **Tiny Tiger** has four, 10 bit analog ins, lots of digital I/O, two UARTs, SPI, I^2C, 1-wire, RTC and has low cost W98/NT compile, debug and download software.

JED makes four Australian boards with up to 64 screw-terminal I/O, more UARTs & LCD/keyboard support. See JED's www site for data.

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DVD aspect ratios are irritating

I can sympathise with Neil Smith (Mailbag, July 2003) on the narrow strip of picture that comes with much of the DVD picture media. Our family recently purchased a DVD player to use with our 4:3 TVs, only to be disappointed when the first two DVD movies we bought were 2.35:1 aspect ratio, which meant half a picture, so we returned them for a refund.

The Internet has a lot of information on this issue and it seems the movie purists, not the big companies, are dictating that DVDs be available with the picture theatre aspect ratios like 1.85:1 and 2.35:1. One site had mention that during film production most of the action is 'framed' at 16:9 (aspect 1.78:1) in the knowledge that the film will eventually end up on wide screen TV.

Some DVDs – I've never found one – are produced double-sided, with 4:3 or 16:9 on one side and original theatre aspect on the other side. If the DVD media is anamorphic (see **www.thedigitalbits.com/articles/anamorphic/** for an explanation), you can set the DVD player to 16:9 instead of 4:3 letterbox which gives the actors elongated heads but for some of us this is preferable to large black zones.

Except for the titles there was never a problem with the old Cinemascope films that ended up on videos. Surely in this day and age there can be a compromise so that all sections of the consumer market can be kept happy – and buying DVDs.

Barry Jorgensen,
Cromer, NSW.

Today's electronics not environmentally friendly.

Today, people think we are being more environmentally friendly because of the efforts to increase recycling. In the world of consumer electronics this is not so. In fact, we are much more environmentally damaging with TVs, stereos and boom-boxes being less repairable today compared to decades ago. To be more environmentally friendly, the manufacturers should make their appliances with cabinets carefully designed and with simpler circuitry to make servicing easier.

I have seen very simple electronic schematics in televisions, boom-boxes, etc and they still perform well. I have even seen TVs that had circuit boards mounted on hinges so the boards can swing out to make things in the sets more accessible. Manufacturers may be taking this approach for profit but look at the dumps. You would be surprised how much electrical rubbish appears at the tip everyday.

My guess is that TV servicemen must be worrying how much electronics there would be in that single "beyond economical repair" television that would be a threat to the environment. Manufacturers should change their ways to create less landfill and more jobs for servicemen by making repairs to appliances more possible.

Chris O'Reilly,
via email.

Comment: there are two cost pressures at work here. Mass production and imports from Asia are inexorably reducing the cost of consumer appliances while the cost of labour for servicing and the cost of maintaining spare parts inventories continues to rise. Inevitably, as time goes on, more electronic equipment will be uneconomic to service. Whether it is practical to recycle old equipment again comes down to economics.

Digital TV is a spectrum grab

Regarding your editorial in the July 2003 issue about the failure of digital TV, this is simply another example of what happens when technically illiterate bureaucrats get into bed with vested interests!

In the 1920s, we had a brand-new 20th century technology (radio broadcasting) being managed by 19th century politicians. We wound up with the infamous "sealed set system" and higher power and lower frequencies reserved for so called "A-class" (government) stations.

Then after many years of conveniently nobbling any possibility of FM broadcasting in Australia by the ingenious tactic of suddenly sticking extra TV channels in the international FM band, FM services were finally announced in the early 1970s - originally to be on the UHF band!

Again after several years of successful outback satellite TV broadcasts on the 4GHz C band, the Government suddenly decided we needed to switch to horrendously expensive and technically dodgy B-MAC on 12GHz. Why? Well, I think that had a lot to do with rumours that certain organisations were thinking of setting up a commercial pirate TV service, targeted to Australia but operated offshore.

Preventing local firms from advertising on such a venture would be a legal and political nightmare and in light of the CB radio experience, so would prohibiting the sale of C-band receivers!

Now we have Digital TV. My own experiences of this (mostly setting up receivers for friends) has been pretty dismal. In one case, the Thomson receiver was completely unable to tune in the ABC or SBS transmissions, despite the analog versions being received with good strength on the same antenna. And with typical Gallic arrogance, the box gave no clue or explanation as to why and there's no manual tuning option. It also rewards you with a completely blank screen if you accidentally tune to an HDTV transmission.

And what do you get for your trouble? Most of the time, Channel 7 and Channel 9 just give you five copies of the analog channel. Channel 10 just gives you one, plus four still slides.

But why, after nearly 50 years, do we so desperately need digital broadcasting now? The fact is, the Government doesn't care about the kind of pictures we watch or their quality. They're just like a lot of greedy relatives trying to push grandma into a nursing home "in her own best interests", when all they really want to do is get their hands on the family mansion. Only in this case the family mansion is a couple of hundred Megahertz of electromagnetic spectrum that they're positively salivating to auction off to the highest bidder, once those tiresome analog TV broadcasts have been put where they belong.

Adrian Kerwitz,
via email. SC

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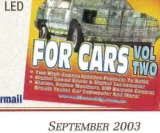


Robot Wars

Competition, sport, combat, you name it, humans are a competitive species. There is nothing like the roar of a crowd as their team "slaughters" the opposition on the field. Whether it is the dignified(?) chasing of balls about a golf course or the intensely physical free-for-all we call football, we love to watch a good contest (even if it is only on TV!).

Of course for most of us, that's all we do. Watch. Actually getting out there and competing in aggressive physical sports requires a lot of training and exercise that we intellectual technical types are usually allergic to – until now.

There's a new contact sport out there and you can be the champion of it without straining any more muscles than you need to win on your PlayStation.

It's called "Robot Wars", "BattleBots" or just plain Combat-Robots.

It's the sport for those who like to battle with brains rather than brawn but still want the adrenalin rush that comes from savagely rending your opponent limb from limb, without risking so much as a personal scratch in the process.

Robot Wars is the ultimate "boys toys" sport, at the same time as being one of the most intense engineering challenges and learning experiences you can find. In principle, it's simple.

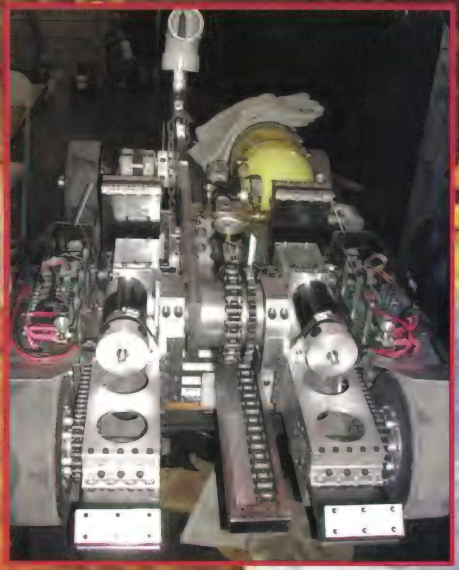
It's Robotic Darwinism or Survival of the Fittest. You create (*cue Thunder-roll and Mad Scientist Laughter*) a heavily armed and armoured remote-controlled destruction machine and unleash it upon your opponent in an arena where two robots enter and one robot and a pile of scrap is left at the finish.

Of course, that's exactly what your opponents have in mind for your machine as well – so your mechanical monster had better be tougher than theirs or *it* will be going home in a robotic body-bag.

Some drivers have compared the adrenalin rush that comes while competing in these events to sky-diving or professional drag racing. Others love the intellectual challenge of building a machine and putting it on the line in a life-or-death match.

And all competitors agree that the planning, design engineering, mate-

The Tech sport of the new millennium



By Brett Paulin

He's called "The Judge" – but he's also the jury and executioner! In combat, all of the exposed mechanics and electronics is well hidden and well protected.

rials science, machining skills, electronics, strategy and just straight cunning is the most enjoyable and creative learning experience they know of.

How did it start?

Back in 1992, a US engineer tried to radio-control his vacuum cleaner to make house-work more interesting.

After viewing the resultant destruction wreaked in his living room, he decided that it was so much fun, that he would organise a competition for people to pit their radio-control creations against each other.

Several years down the track, there are now two major TV shows, thousands of competitors, a wealth of websites, PlayStation and PC Video Games, remote control toys, Internet Chat Forums, and even McDonald's happy-meal plastic toys of the most Famous BattleBots in America.

The sport is continuing to grow and diversify as people push the boundaries of what can be done with machines to destroy other machines.

Watching machines beat the bolts out of each other is a hit. It has Quality Violent Destruction and no one gets hurt, physically, that is. Economic? That's another matter!

Australia is just starting to catch up with the rest of the world in this new sport, with new teams in every state forming and building their first robots, and starting to organise local events with a view to holding a national event soon.

The Channel 10 network has been screening the UK "Robot Wars" series while waiting for the sport to grow locally. Welders are arcing and soldering irons are smoking as the first generation of uniquely Australian robots come to life.

Are they really robots?

Are they really robots? A common question, given that most people think

. . . into the valley of death, they rode . . . These hydraulically-operated crusher jaws can (and do!) operate with a force measured in tonnes and are designed to disable an opponent robot by literally crushing it to death.

of C-3PO or Terminator when imagining a robot and something that looks like a remote-controlled ditch-digger doesn't quite qualify.

Well, being remote-controlled (by a human!) they are not autonomous, so full-on robots like C-3PO might be affronted but if C-3PO wants to argue about it, then he had better bring along a light-sabre to do so, because these robots are NOT the sort to politely disagree.

There are "Autonomous" (self-directed) classes but that's a subject for another article. For the moment, remote-controlled machines are where the real excitement is, since they have a cunning human brain behind the steel muscles and the action is a lot more "personal" in nature.

Rules

Rules? Well, yes, there ARE some or it wouldn't be long before someone equipped their robot with hand grenades or a Tesla coil and vaporised everything within sight. This is supposed to be a FUN sport and having to compete and watch from a concrete bunker in the desert via TV wouldn't quite be the same.

Basically, "Kinetic Energy" weapons are the norm – things that smash, cut, rip, flip, puncture and crush. Saws, hammers, spikes, flippers, wedges, drills, flywheels, clubs, pick-axes (no, not the chip) and any other destructive or fiendish implements you can devise are permitted.

Prohibited weapons include explosives, electrical discharges or radio jamming, chemical/corrosive substances, nets, fire (in most cases) and radiation of any sort (lasers, masers, gamma beams etc).

Why? Safety is the first reason – your rocket launcher or napalm-gun may sound like a cool idea, until it misses its target and hits something else. Hopefully, whatever else it is will be strong enough to stop it before it then hits a spectator, so long-range weapons are out. All projectiles must be tethered to the robot.

"Maximus" is a classic flipper-type robot, intended to disable the opposition by turning it upside-down.

Second, entertainment is the name of the game. Watching one machine rip chunks of steel off another with a saw is much more fun than a light tap with an electrode bearing 100kV which instantly fries the electronics and leaves a visually undamaged robot sitting still like a stunned mullet. Likewise radio jamming is banned as there is little point in having robot machines helplessly twitching, with the fighting going on in a realm that can only be seen on a spectrum analyser. Most of the prohibited weapon rules are either for your protection or your entertainment.

You will be amazed at the wide variety of machines possible within the scope of these rules. Every competition reveals a new idea that has competitors re-designing and re-engineering their machines to meet the opposition's latest threat.

The rules vary slightly from compe-

The "pits" at a typical Robot battleground. You'll find every possible configuration of robot, in all weight categories, with every conceivable (and probably some inconceivable!) weaponry and defence mechanisms.

tition to competition, since some allow flame throwers and some don't; some allow internal combustion engines (ICE) to power spinning blades, etc and others are worried about the fire hazard they present. Some events are limited by the strength of their arena walls, so have a maximum weight class they can handle. At one event in America recently, a super-heavyweight Hi-Speed (150kg) Rammer Robot missed its target and smashed clean through a foot-thick brick wall into the car park!

A basic rule set that most events build on can be found at the American Robot Fighting League (RFL) website at **www.botleague.com**

Types of robot

So, you have an unbeatable design in mind? Most effective robot designs fall into a few major categories, each with their own strengths and weaknesses – although sometimes a new design will appear that defies description, so this is only a rough guideline. Feel free to innovate and come up with something that does not fit into any of these pigeonholes to surprise your opponent. Just make sure your "secret weapons" will pass the safety rules.

Wedges – the simplest type of robot, basically a mobile door-stopper, low to the ground to get under the other robot, scoop them and push them around the arena – hopefully flipping them over. Often sneered at since they don't have an active weapon, they are still popular since they are the easiest to build.

Lifters – like a wedge, with the addition of a moveable arm that makes it easier to either flip the other robot over or lift them and pin them against the wall. These are very effective against robots that cannot self-right or drive inverted but ineffective if their opponent has either ability.

"Bone Saw" – aptly named, because it could!

Flippers – high-powered lifters, usually driven by compressed gas pneumatic rams, often capable of tossing other robots high into the air and causing massive damage when they crash back to the ground. These can be very dangerous and tricky to build unless you have experience with high-pressure gas.

Rammers – powerful, fast bulldozers are designed to shove the opponent around the arena, into the walls and physically slam into them at high speed to cause damage; often fitted with spikes and wedges to penetrate the opponent upon impact.

Spinners – the masters of destruction, fitted with high-speed spinning flywheels with cutting or bludgeoning teeth on them. They cause massive damage and sometimes rip pieces off the other robot and send them flying. The bad news is that they often break themselves as well, since the law of action and reaction means they absorb the same impact energy back into their own frames. There are limits on where they can compete though, since bulletproof arenas are required to pro-

tect the spectators from flying fragments.

Hammer-Bots – swinging sledge hammers and pick axes. These are impressive but difficult to build, since accelerating heavy hammers quickly and repeatedly requires ingenious mechanics and powerful motors. Often, they are powered by pneumatic rams like flippers – a very effective design when done well, since many robots have weak overhead armour and sometimes the hammer can be used as a self-righting mechanism as well.

Crushers – Hydraulic-powered presses, sometimes with penetrating spikes to concentrate the forces into a small irresistible point. Not a very popular design, since their jaws move very slowly and it's easy for an opponent to escape. They also require careful engineering of their frame to withstand the enormous forces they have to exert without bending.

Circular Saws – visually exciting, often sending off showers of sparks, they usually also require a way of temporarily immobilising the opponent, since it's hard to saw something that won't sit still. Clamping jaws of some sort make them a lot more effective.

Thwack Bots – an unusual type of spinner, the whole body of the robot is spun around by driving its two wheels in opposite directions, with a hammer or spike on an extended arm. The principle is that all of the robot's spinning mass goes into the impact. The drawback is they can't move around while spinning, so the opponent often just sits back and waits for them to stop spinning before attacking.

Weight classes

The biggest rule is WEIGHT. Obviously, there have to be limits here or someone would fit a remote control to an M1 Abrams Tank and laugh while picking bits of the opposing robot out of their treads after the match.

To keep things (relatively) sane, all robots have to fit into a weight class, and are only expected to battle other robots of the same class. Your robot can weigh anything up to the maximum weight for a particular class. If you go over it, you are up into the next class and will be battling much fiercer machines, so keeping an eye on your machine's weight is most important.

The accepted weight classes are:

Ant-weight:	0.5kg
Beetle-weight:	1kg
Hobby-weight:	6kg
Feather-weight:	12kg
Light-weight:	25kg
Middle-weight:	50kg
Heavy-weight:	100kg
Super-Heavyweight:	150kg

Naturally, the heavy and super-heavy classes are what most people dream of building, since they are the most destructive and spectacular. They are usually the ones that get the most TV coverage.

However, they are also the most expensive by far. Motors, batteries and electronics that can muscle 150kg of steel about at high speed are not cheap, and you will probably have to settle for something lighter to start with. The Feather-weight class (12kg) is looking to be a very popular class to start off in within Australia, with the robots still big enough to be impressive but small enough to be manageable without a crane and a trailer. When was the last time you tried to move a 150kg machine around your workshop? Feathers will fit on your workbench, in your car boot and cost a lot less to build with more easily available parts. You can always scale up later if the bug really bites you.

Is that *really* a lawnmower blade up front? Sure is – but don't try mowing your lawn with this one!

How much does it cost?

As far as hobbies go, this is not a particularly cheap one, unless you stick to the lower weight classes. The ant and beetle weight class robots can be built for around $200-$300 with modified hobby servo motors, cheap radios and batteries being sufficient to power them. You can have a lot of fun in these classes and they are perfect for dads to screw together on their electronic workbenches with a soldering iron and hot glue, for their kids to battle without breaking too many expensive parts.

The hobby and feather-weight classes start to get a bit more expensive, since you need more powerful motors to carry the extra weight, bigger batteries and some serious electronics to handle the higher currents to power these motors. Add in multi-channel radio control and you are probably heading for $1000 without too much trouble.

From Light-weight and upwards, costs really start to climb, unless you are willing to do a lot of scrounging in junkyards and surplus shops for used parts. Fortunately, here in Australia where the sport is just starting to take off, the level of competition isn't very intense yet, and you have a reasonable chance of winning with a machine cobbled together with your home welder, using salvaged metal and motors. In fact, that's how most of the robots here are made now.

In the USA, some of the top-ranked heavy and super-heavy weight machines have cost up to $45,000, with CAD designed, custom water-jet cut parts carved from blocks of ultra-strong titanium alloys, custom-wound electric motors and CNC machined gears and drive-trains. Some of the teams show up with semi-trailer workshops and team uniforms, since there's national TV coverage and fame to be had for winning the championship at the bigger events. Sponsors will often weigh in with money and parts to help out the top TV teams.

Back in Australia, we haven't reached that level of professional competition just yet, so now is a good time to get into it and have a good time relatively cheaply before the players with big dollars move in and start to raise the competition level bar.

Robot electrical systems

Most combat robots are powered purely by electricity – batteries, permanent magnet DC motors and electronic speed controllers. Some more advanced designs use petrol engines,

Some combatants really go into it in a b-i-g way. This pantech is the mobile workshop for the Team Van Cleve in the US. (www.teamvancleve.com)

pneumatics, hydraulics and other technologies which we won't go into right now. Electrical robots are the simplest and easiest to construct, the most reliable and the safest. They are probably more likely to be of interest to readers of this magazine.

The components that make up an electrical combat robot can be split up into the following categories.

Power source

In most cases, this means batteries. The most common types of batteries used in combat robots are either "SLA" (Sealed Lead Acid) or Nickel-Cadmium (Nicad) batteries. They need to handle heavy sustained discharge currents for five minutes, while still being reasonably lightweight and physically robust.

Radio control system

Most combat robots use model car or model aircraft radio control systems to drive and actuate their weapons. A basic ramming or wedge robot will need a two-channel system to drive the left and right motors. Weapons require additional control channels to activate.

Drive control electronics

The Electronic Speed Controller (or ESC) takes the pulse output from the radio receiver that is normally used to drive servo-motors and converts it into a bidirectional, pulse width modulated signal. This is then used to drive high current Mosfets to vary the power applied to the drive motors, to move and steer the robot.

Weapon control electronics

Most of the time, robot weapons can be activated with a simple relay or two. You will need some electronics to change the receiver's servo drive signal into a relay switch. Some speed controllers have these built-in, otherwise servo relay adapters are available from radio control shops (like Silvertone Electronics).

Electric motors

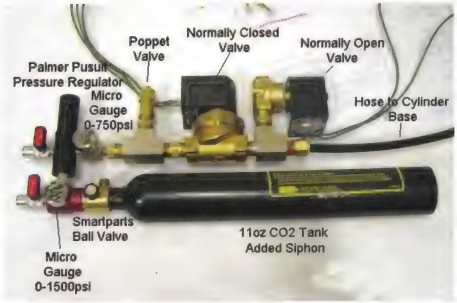
Depending on the weight class, these can range from small hobby motors up to huge 15 horsepower beasts that draw hundreds of amps. Combat robots are usually made from motors adapted from some other application to keep the costs down. Popular motors can be obtained from battery-powered screwdrivers and drills (since they include gearboxes), windscreen wiper and car thermo-fan motors, and even electric wheelchairs and golf buggies.

Wiring and isolation

The wiring of a combat robot is critical. Remember this thing is going to be pounded on, crashed into, flipped, crushed and spiked.

The number one cause of failure of most combat robots is wires coming loose under the forces experienced. Also, the wiring must incorporate a safety isolation switch to totally disable the robot (for obvious reasons) and be able to handle the large currents needed by the motors in shoving matches.

Of course, major damage does occur – that is the name of the game, after all. It only takes one wrong move to get your robot caught by an opponent. The idea is to be more agile, have more power and weaponry and give the opponent minimal opportunity to cause you damage.



Here's a typical carbon dioxide (CO_2) setup for flipper control. Remotely controlled via radio, it gives a sudden and powerful lift to the flipper mechanism.

Failsafe

In addition to the physical isolation switch to remove power, all robots require some electronics to ensure that if the radio-control link is lost for any reason, it will return to a safe (deactivated) state. Commercial units are available for this and some speed controllers have them built-in.

More information

A recent interesting development is the inclusion of Combat Robotics as an approved school curriculum course. Engineering teachers the world over are finding it's a great way to interest students in robot mechanical and electrical/electronic engineering. So many school or class-based teams started appearing at the events in the United States, that a special "Battle-Bots IQ" organisation was formed specifically to encourage young builders to do a school-approved course. Studying a wide range of engineering disciples is necessary to build a robot, with the culmination of the course being to construct and compete with a BattleBot at an event.

This course has proven to be enormously popular. It is hoped that something similar will occur soon with the TAFEs and universities of Australia seeing the opportunity to encourage young minds in this rapidly growing field of robots.

Well, that about covers the basics of Robotic Combat. The rest is up to your imagination!

There are a number of "forums" where you can chat with other builders and enthusiasts, surf a plethora of websites with detailed build reports, guides, frequently asked questions and parts for sale. In addition, quite a few builders use MSN Messenger or ICQ for online chatting about what's going on and to keep in touch. To help you on the way, here is a list of the best places to find out more about Robotic Combat.

Australian Sites

www.robowars.org – a Melbourne-based group of builders, (including the author of this article!). Check the links page for connections to other Australian-specific sites and contact details for the other Australian builders. We hold regular meetings where builders can get together, help each other out and view videos of the latest events from around the world.

www.abbl.org – an all-states group with a good chat-forum/bulletin board to discuss building online.

www.robothavoc.tk – a new site, aiming to compile information on the robots and teams from around Australia; not much content yet but one to watch in future.

International Sites

www.robotcombat.com – the leading Robot Combat website. Also the Team Nightmare website, with a huge automatically-updated daily links section to practically every other robot-related website out there, allowing you to find the latest news and content quickly. It also incorporates the Robot-Marketplace where you can find everything you need for Robotic Combat, parts, books, videos, motors, and more.

www.battlebots.com – The producers of the BattleBots events and TV show in the United States.

www.robotwars.co.uk – The producers of the Robot-Wars TV show in the United Kingdom

forums.delphiforums.com/BattleBot_Tech – The US-based on-line chat forum; great technical info here.

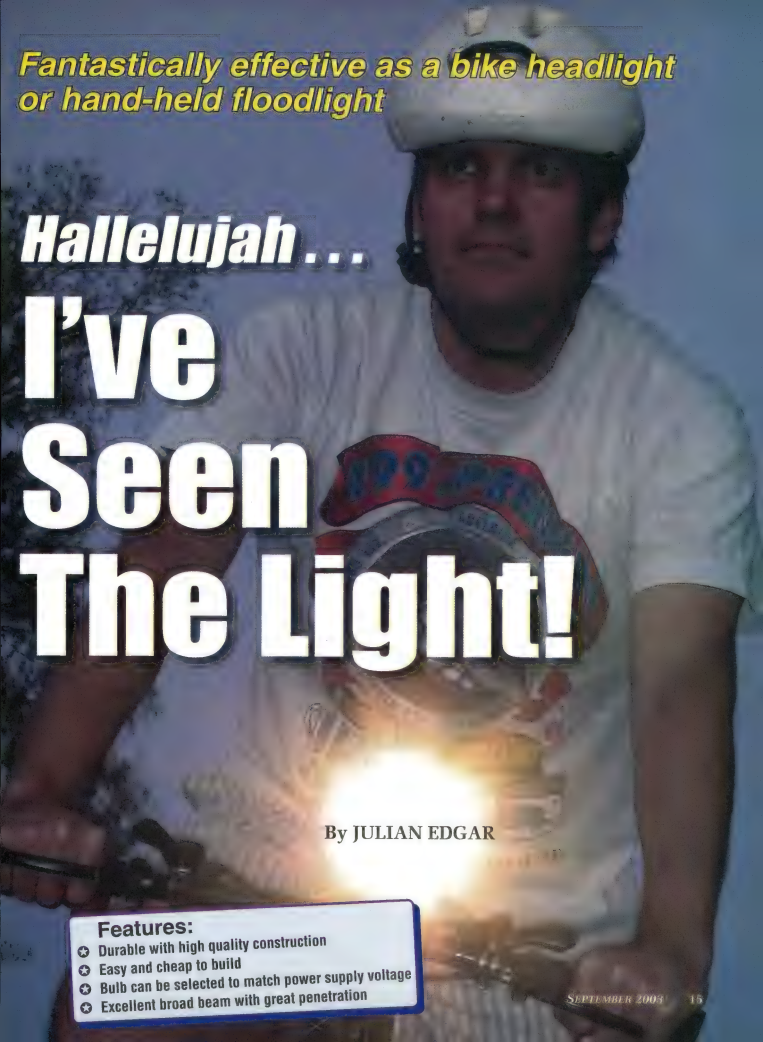
Acknowledgement

Thanks to Jim Smentowski of Robotcombat.com, John Mladenik and Don Shiver for permission to use their robot photos from around the world. **SC**

Lightweight bot "Backlash" can inflict some heavyweight damage!

Fantastically effective as a bike headlight or hand-held floodlight

Hallelujah . . . I've Seen The Light!



By JULIAN EDGAR

Features:

- Durable with high quality construction
- Easy and cheap to build
- Bulb can be selected to match power supply voltage
- Excellent broad beam with great penetration

Our new DIY bike headlight is just the thing if you want to see where you're going at night – or have others see you coming. Rather than casting an anaemic spot of light on the ground only a few metres ahead of the bike, this headlight will throw a swathe of light with at least a 50-metre range. It's also durable, easy to build and costs little. You can power it from a conventional cycle generator, normal or rechargeable batteries, or do what we've done – and that is build a dedicated sealed lead acid (SLA) battery pack.

IN FACT, the package of our headlight and SLA battery pack makes for a really great bike headlight system – plenty of light, excellent durability, very cheap running costs and an up-front price that's well under many premium bike lighting systems.

Or if you wish, you can place the SLA battery in a shoulder or belt pack and use it as a very powerful and light hand-held floodlight.

The design

So what makes this design so effective?

Firstly, the light beam is tightly focused by a convex glass lens. But isn't this expensive?

Well, no – not when you use a magnifying glass! The lens used in our bike headlight is a 70mm diameter magnifying glass. And it is *actually* glass, rather than being made from plastic. Using such a large lens works very well in focusing the beam which is produced by an incandescent bulb and its dedicated reflector.

Secondly, the design uses a good quality multi-faceted reflector. It's from an Eveready torch – model E250K (and it appears that the Eveready E220, E250 and E251 torches are very similar).

This is a two 'D' cell torch with a reflector that's 45mm in diameter. It costs about four dollars so it's certainly not expensive. We'd expect that any torch with a decent quality reflector would be able to be used in this application.

Finally, the bulb is matched very carefully to the battery so as to give a very good output while having appropriate durability.

Bulbs, bulbs, bulbs

The bulb that you use in the headlight depends on how you intend powering it.

If you are using a 6V sealed lead acid (SLA) battery, you can use a 6V 0.5A Eveready torch bulb. Most of the design and development was based around this bulb – with this bulb fitted, the headlight gives out plenty of light. This is the bulb we'd recommend.

If you want more light (and a little less endurance), Mag-Lite make a very high performance krypton bulb that's suitable for use with a 6V SLA battery. It's designed for use with 5-cell torches. At 6.2V, it draws 0.67A and is Part No. LWSA501U.

It's amazing what a few "odds-'n'-ends" can become: a drink container becomes a superb pushbike light!

If you are powering the light with a 6V lantern battery, the 4.8V 0.7A krypton bulb normally found in an Eveready Dolphin-type torch works extremely well. The reason that the 4.8V bulb cannot be used with the 6V SLA battery is that when the battery is fully charged, the SLA battery will actually have an output higher than 6V – and this causes the 4.8V bulb to have a very short life.

If you want, you can even use a 2.4V krypton bulb and power the headlight via two D-cells, or a 2.2V bulb and use two rechargeable D-cells.

So as you can see, the headlight is very versatile!

But which ever bulb you use, make sure that it is a high-quality brand name bulb – don't be tempted to replace it with a cheap generic one. We made this mistake during the development of the headlight and both the light output and the quality of the beam pattern suffered.

Note that when built exactly as described here (ie, using this lens, reflector and the 6V 0.5A bulb), there will be a slightly darker spot in the middle of the beam. Replacing the plastic "lens" from the original torch (which has a matte-finish circle in the middle of it) back into the holder will help remove this spot but this also reduces the overall light output slightly.

The housing for the torch is rustproof stainless steel – but it's not expensive as in its former life it was actually a drinking cup!

The moulding around the front of the lens is made from a U-PVC pipe cap, while the stainless steel and plastic mount was obtained from a marine shop.

The reflector support inside the headlight is formed from the front part of the Eveready torch, while a weatherproof switch on the back of the headlight is from a marine or electronics shop.

Finding the Lens Focal Length

This sounds complex but it's actually dead easy.

While inside, hold up the lens to a bright window. Behind the lens place a piece of white card (or use a light-painted wall opposite the window) and move the lens closer and further away from the card/wall.

When you can see a sharp image of the distant scene outside the window on the card, accurately measure the distance between the lens and the card. That is the focal length of the lens.

The completed headlight has a mass of just 300g.

Making it

(1). The housing

The first step in making the headlight is to obtain the stainless steel drinking cup.

The one shown here has a front diameter of 75mm, a rear diameter of 50mm and a height of 100mm. These dimensions aren't critical – so long as you adjust the other parts requirements to suit. So, the glass lens will need to have a diameter that matches the opening size of the cup, for example.

Stainless steel has a huge advantage in this application – it's rustproof. Aluminium cups can also be used (they're also rust-proof) but they're not quite as strong.

(2). The lens

Once the cup has been acquired, buy a **glass** magnifying glass to suit the cup's mouth diameter. Don't buy a plastic magnifying glass – not only

will it scratch easily, it will also discolour over time and won't have the light transmission or other optical properties required.

The 75mm magnifying glass used here was bought from a newsagent for $4. It had a focal length of about 18cm and was originally mounted in a plastic holder.

(3). Front moulding

Once you have the lens sorted, you'll need to buy a plastic pipe cap from a hardware store. The cap needs to be a tight fit over the end of the cup and in

our case, a 75mm pipe cap was perfect.

Using a hole-saw and/or a sharp knife, cut out the centre of the cap so that you're left with just the rim and a

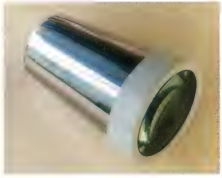
small width of front face around the edge.

The glass lens should fit inside the cap and the cap should then in turn fit tightly over the end of the stainless steel housing.

After you've used a file and then fine sandpaper to clean-up the cut inner edge of the pipe cap, use silicone adhesive/sealant to glue the glass lens inside the cap. Don't smear it all over the glass – surplus sealant can be

removed using a rag moistened with mineral turps. The silicone should form a watertight seal around the lens.

You should then be able to trial mount the front lens in place.



(4). Reflector support

As mentioned earlier, the reflector and its support are obtained from an Eveready torch.

Unscrew the reflector and lens end of the Eveready torch and then very carefully remove the reflector and the plastic "lens". This lens won't be used

though, because it reduces the overall light output.

A hacksaw can then be used to cut off the front end of the torch – the black collar and its threaded section.

You should be left with a highly

Parts List – Lamp

- Reflector and lampholder from suitable torch (see text)
- Bulb to suit battery used (see text)
- 70mm (approx) ***glass*** magnifying glass
- Stainless steel drink cup
- 75mm (approx.) pipe cap
- Weatherproof toggle switch (5A DC)
- Mounting bracket
- Silicone sealant
- Medium/heavy-duty fig-8 cable
- Stainless steel self-tapping screws

polished multi-faceted reflector, a black collar and its associated male thread (not shown), and the cap that screws down over that collar. Because the lens is now removed, when the reflector is re-inserted into its holder and the cap screwed down over it, the reflector can rattle. To cure this, place a rubber ring inside the holder (we used an old drive-belt from a VCR).

No LEDs?

You may be wondering why we're using a relatively power-hungry incandescent bulb for this bike headlamp, rather than much more efficient high-intensity white LEDs.

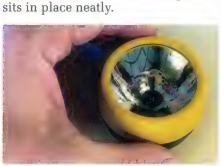
Well, we wanted to use LEDs and spent a long time working with different LED prototype headlights. We tried multiple LEDs bunched together, we tried total internal reflection (TIR) optical guides directing the light from lots of LEDs to the one focal point (and then focusing that beam), and we tried multiple LEDs – each in its own reflector. But none of these headlight designs produced enough light: while a LED works in a small torch, for a bike headlight where a much broader bright beam is needed, LEDs can't (yet) cut it.

To get a broad, high intensity beam, the only way was to use a traditional (albeit high-quality) bulb. However, we've made the very best of that light by using a good quality reflector and then a giant focusing lens. The resulting output rivals 12V dichroic halogen reflector lights using up to seven times as much power.

The reflector will now be held firmly in place when the cap is screwed down.

The assembled reflector should look like the one shown below. (The plastic 'lens' is left out because it will absorb some of the light and the completed headlight is weatherproof anyway.)

This complete assembly should now slide down inside the cup, with the front face ending up about 40mm down from the mouth of the stainless steel housing. The taper of the reflector housing is a good match for the taper of the stainless steel cup, so it sits in place neatly.



So that the bulb can be replaced when it blows, the bulb/reflector assembly needs to be able to be removed when necessary – so you can't just glue the whole holder in place inside the cup. Instead, two self-tapping stainless steel screws are inserted from outside the cup, so that they screw into the plastic part of the reflector holder. Drill pilot holes for these and place a dob of sealant on each of them before screwing them home.

But don't do it quite yet – there are lots of steps to come first!

(5). Power for the bulb

Power to the bulb comes via two wires that are soldered into place. One is soldered to the back of the bulb holder (where once the positive terminal of the battery nestled home) and the other to the metal rim around the bulb holder. You can now solder these wires into place, using reasonably heavy-duty figure-8 wire.

Remove the 2.4V bulb that was supplied with the torch and replace it with a bulb to suit your power supply (6V for the 6V SLA battery or, as shown here, 4.8V for 6V dry batteries). Apply power to the bulb and make sure that it shines brightly.

Next, drill a hole in the lower part of the stainless steel housing where you want to the cable to come out, then insert a grommet and slide the

cable through it. Place the reflector and its holder in the cup, put the glass lens in place and then check out how good the beam is.

When shone at right-angles against a wall, the prototype headlight had a circular spot diameter of 60cm at a distance of three metres. While this sounds very narrow, when you consider that the beam range is about 50 metres, it spreads out nicely. In fact, one of our design aims was to have a

headlight that was wide enough in beam spread to attract the attention of motorists (ie, to allow the bike to be spotted) while at the same time illuminating plenty of road.

If your beam is too narrow (or too broad), you'll need to look at changing the reflector-to-lens distance, or the focal length of the magnifying glass. Experimentation is the simplest way.

(6). Power switch

The switch needs to be weatherproof. Marine stores sell 12V weatherproof switches, while some electronics stores sell weatherproof rubber boots, or caps, that fit over normal toggle switches. So that we could use a small switch, we took the latter approach here. The switch is mounted on top of the lamp housing towards the rear, where it clears the internal reflector support but is easy to get at. Drill the hole for the switch and mount it now.

Mounting it

The headlight is mounted using a polycarbonate and stainless steel 'adjustable rail clamp', bought from a

marine supplies shop (we used clamps from Whitworths Discount Marine Supplies, Cat. 70482 at $6.95).

A hole was drilled through one arm of the clamp and a large diameter screw inserted through it. A washer and a nut were placed against the clamp, then the screw attached to the lamp housing. Washers and nuts were used either side of the stainless steel of the cup.

(Note that the back of the reflector plastic mount may have to be cut away a little to give clearance to the nut).

All the hardware is stainless steel – the bolt, nuts and washers. Stainless steel fasteners can be obtained from marine stores – again we bought them from Whitworths.

The clamp was set up in this way so that easy adjustment of the side-to-side aiming is possible (just loosen the nut against the clamp), and easy up/down aiming can also be carried out (just loosen the clamp).

The slight 'stand-off' also gives room for the clamp screws to protrude past the clamp, as will happen when

How Long Will The Battery Last?

So with a fully charged battery, how long will the light last?

That's a much harder question to answer than it first appears – but in short, a good length of time.

But isn't it easy? Don't you just divide how many amp-hours the battery is rated at by the current the bulb takes? So, with a 0.5A bulb and a 4.2Ah battery, won't the bulb last 8.4 hours?

Well, yes and no. The manufacturers of batteries provide curves showing discharge versus voltage – but so much depends on the starting voltage (ie, how fully charged the battery is), whether the current draw is continuous or in short spurts and, of course, the load.

The 4.2Ah battery shown here is actually rated by the manufacturer as a 3.4Ah battery when supplying a current draw of 0.68A for 5 hours.

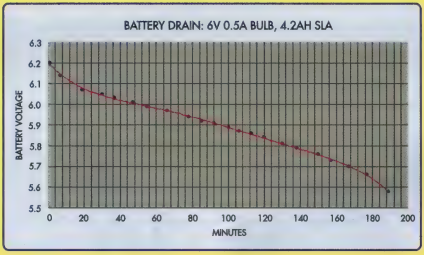
*However, we did some careful testing to make sure that the battery wouldn't fall over in 30 minutes or something terrible like that. With a starting (under load) voltage of 6.2V (6.44 without the load), the battery had the following actual performance when **continuously** powering a 6V, 0.5A bulb.*

It took just under an hour before the battery voltage dropped to 6V. By the end of the second hour, the voltage was over 5.8V, and by the end of the third hour it was 5.6V. However, when left switched off overnight, the next day under load the battery had jumped back up to 5.8V – see what we mean about the difficulty of getting a clear picture?

In discontinuous use, we'd expect no problems with at least four hours of light – and in continuous use, three hours should not be a problem.

And then, of course, you just plug in the charger and for a few more cents you have another 3-4 hours of light.

This is much cheaper than buying more batteries – and also much simpler than pulling out rechargeable double-As and inserting them into a charger – and then remembering to put them back into the headlight.



Parts List & Sources: 6V Battery Pack

- 6V SLA plug-pack battery charger
- 6V 4.2Ah rechargeable SLA battery
- Alloy box
- Fuseholder and fuse
- Waterproof plug and socket
- Frame clamps and stainless steel nuts and bolts

The first four items were purchased from electronics supply stores, and the last two from a marine supplies shop.

After much searching to find a matching box and battery, the battery was purchased from Jaycar Electronics (Cat. SB-2496) and the box from Dick Smith Electronics (Cat. H-2206).

Unfortunately, the box is a fraction (like about 1mm!) too small in height and so the lid stands a little proud when it is screwed down. However, this holds the battery very firmly in place and a watertight seal is still retained by the use of some silicone sealant around the lid.

Any size 6V SLA battery can be used – the one shown here was chosen on the basis of its compact size and good capacity. If you go smaller you'll have less hours of light; bigger capacity equals more hours of light.

So if you'll never want more than (say) an hour of light in one stretch, you could use a smaller SLA 6V battery.

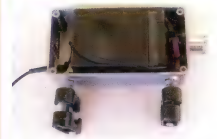
The plugpack charger is from Jaycar, Cat. MB-3516, designed specifically to charge 6V SLA batteries. It charges at 0.5A and then when the battery is fully charged, automatically switches to trickle charge. This change in charging state is indicated by the LED on the charger starting to flash. This means that the charger can be left plugged into the battery pack for long periods without any problems – and that the battery will always be ready to go but not overcharged.

The waterproof plug and socket was bought from marine suppliers Whitworths. It is much heavier duty than is really needed but we couldn't find any smaller weatherproof designs. The plug doesn't need to be weatherproof but the socket needs to be able to be sealed off when the bike is out and about. Also, you don't want the socket to rust or otherwise corrode.

One advantage of this socket is that it has a weatherproof cap on a captive chain – always screw it on whenever the battery isn't being charged, as the terminals are always 'live'.

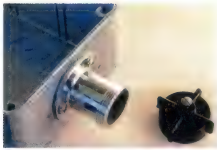
The stainless steel and polycarbonate frame clamps and hardware are the same as used in the headlight design.

The completed battery pack has a mass of 1.4kg.



has good endurance, and is convenient – you simply plug a pre-built battery charger into the battery pack whenever the bike isn't being used and unplug it when you take the bike out. It's an ideal match with the 6V 0.5A bulb. It will cost mere cents to charge the battery this way – so low, in fact, that it may not even turn the electricity meter!

Another possible alternative: if your bike is left outside during daylight hours (eg, after riding it to school or work), you could even place a small solar cell or two somewhere on the bike and charge the battery with free electricity from sunlight during the day. We haven't tried this but it's certainly an option.



they're finally tightened.

Final Assembly

The final assembly process involves using sealant – around the self-tapping stainless steel screws that hold the reflector holder in place and around the plastic rim at the front of the headlight.

You'll need to break this seal and undo the screws to change the headlight bulb. Another approach is to use a large O-ring around the underside of the rim. The O-ring will prevent leakage of water into the headlight without any sealant needing to be applied.

The clamp can be used to mount the headlight on the bike handlebars.

An SLA battery pack

This 6V rechargeable battery pack is easy and relatively cheap to build,

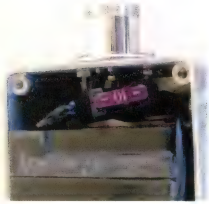
Building it

The first step is to drill the box to take the charger socket. This requires three holes for the mounting screws and a larger central hole for the cable access.

The screw cap is normally retained on a chain but here it has been removed to facilitate the mounting of the socket.

The mounting clamps are next, and – as with the headlight – these clamps are spaced away from the box using stainless steel nuts and screws. This gives enough room for the adjustment screws to be tightened so that the clamp can grip the bike frame.

Washers are used on the inside and outside of the box to help distribute the load – remember that the battery is quite heavy and the forces applied by the bike as it rides over bumps can be quite large.



The wiring is very simple – the two socket terminals are connected to the battery terminals via a fuse and the power supply for the headlight is taken off after the fuse. For safety, the fuse should be located as close to the battery as possible. Here, a blade (ie, automotive type) fuse and holder were used. A hole needs to be drilled for the headlight supply wiring to escape and that's about all there is to it!

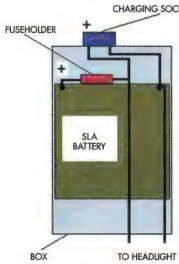


Fig.1: how to wire the SLA battery pack.

Fig.1 shows what the circuit looks like. Make sure that the fuse is located as close to the positive terminal as possible and remember that the charging socket terminals are always 'live'.

A 5A fuse is quite sufficient, however I didn't have a lower value than 10A lying around so I used that.

The SLA battery charger comes with female spade terminals attached. These need to be removed and replaced with the plug to match the already-installed socket. Make sure that you get the polarity right – ie, that the positive terminal from the charger (the one with the red connector on it originally) goes to the positive of the battery!

After that, it's just a case of putting the lid on the box, sealing around it with some silicone for waterproofing and finally checking that it all works.

The three parts of the project: top left is the battery pack, top right is the pushbike headlamp itself, and at right is the very-slightly-modified commercial battery charger.

Conclusion

The SLA battery pack is easy to use, safe in an accident (it would be nearly impossible to get an acid spill) and is pretty cheap to put together. Even if the headlight is used frequently, it should provide years of service, with running costs that can be measured in cents. **SC**

Headlamp Durability?

This headlamp should be very durable. The stainless-steel housing will stay rigid and corrosion-free, the polycarbonate mount with stainless-steel nuts and bolts is marine grade, and the glass lens won't go milky or soften. The reflector – while being used with a higher powered bulb than intended – doesn't get excessively warm, while the bulb itself is being used strictly as designed. The rubber-booted switch should be fine, and the cable grommet should weather wind and sun and rain without problems. The front plastic rim is UV-stabilised PVC – in short, this headlight should work well for many years. However, as with any component exposed to sunlight, painting the headlight body will give it even better longevity.

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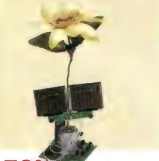

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60MHz Probe CRO	100MHz Probe CRO
Working voltage: 600V AC p-p (x10)	600V AC p-p (x10)
Input Capacitance: 170pF (x1), 27pF (x10)	150pF (x1), 18pF (x10)
Input Resistance: 9MΩ (x10)	9MΩ (x10)
Bandwidth: 60MHz *Q 1247*	100MHz *Q 1249*

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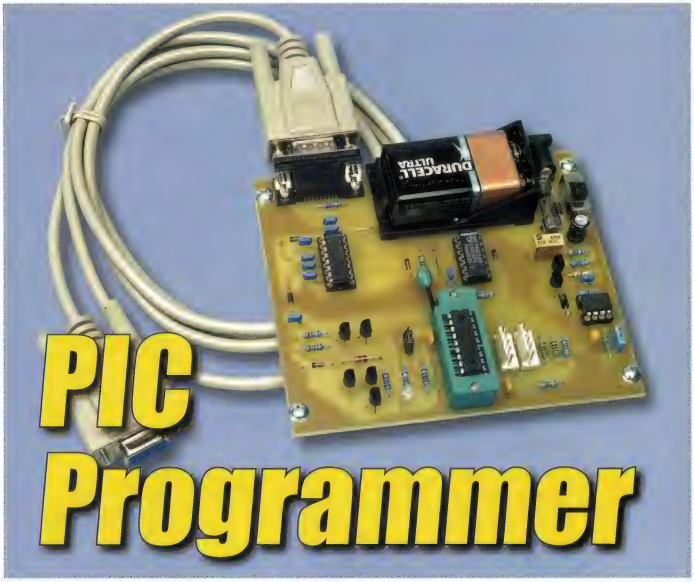


PIC Programmer

Pass your PIC programmer around the classroom or take it out on the road using this portable, robust design! It can program popular PICs as well as serial EEPROMs.

By PETER SMITH

UNLIKE PREVIOUSLY published designs, this new PIC programmer can be battery powered for portable use. It can also program all the latest 8-pin and 18-pin devices, including the PIC16F628A and PIC12F629.

Another important addition is power supply current limiting. This feature makes it virtually impossible to destroy a PIC, even if it is accidentally reversed in the programming socket (great for instructional use)!

We've also included rudimentary in-circuit programming support. A five-way header on the programmer can be connected to your prototyping board for in-circuit reprogramming capability. This means that there's no need to unplug the PIC (which may be difficult to get to) each time you want to test a change to your code.

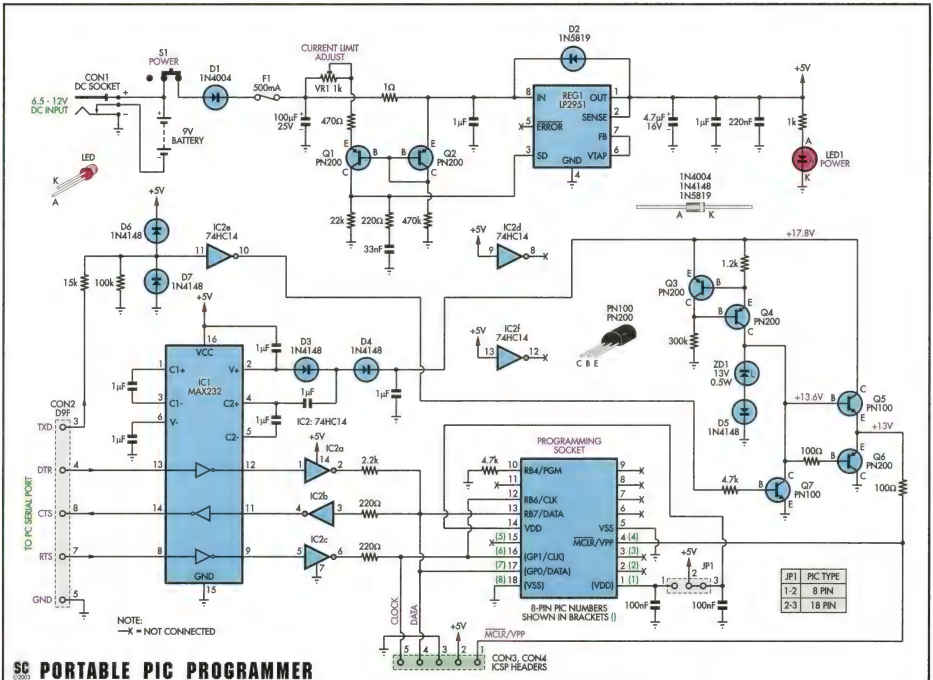
Finally, a second header has been included for connection to a user-wired programming adapter. This provides a means of programming the 24CXX family of serial EEPROMs, as well as 28-pin and 40-pin (16F87X series) PICs.

How it works

For ease of explanation, let's divide the circuit into three sections; power supply, programming interface and V_{PP} generation and switching.

Power for the circuit can be either

Fig.1: the circuit diagram for the PIC programmer. PIC programming is performed via the RS232 interface, with IC1 & IC2 providing the connection to the programming socket.



PORTABLE PIC PROGRAMMER

Parts List

1 PC board coded 07109031, 100.5mm x 117mm
1 DPDT PC-mount slide switch (S1) (Altronics S-2060)
1 18-pin ZIF socket or IC socket (SKT1) (see text)
1 9V PC-mount battery holder (Altronics S-5048)
1 M205 500mA quick-blow fuse
2 M205 fuse clips
4 small stick-on rubber feet
3 No. 4 x 6mm self-tapping screws
1 9V DC 150mA (min.) plugpack (optional)
1 1kΩ 20-turn or 25-turn trimpot (VR1)

Semiconductors
1 MAX232 RS232 receiver/driver IC (IC1)
1 74HC14 hex inverter IC (IC2)
1 LP2951CN or LP2951ACN voltage regulator (REG1) (Farnell 334-3674)
5 PN200 PNP transistors (Q1-Q4, Q6)
2 PN100 NPN transistors (Q5, Q7)
1 13V 0.4W (or 0.5W) zener diode (ZD1)
1 1N4004 silicon diode (D1)
1 1N5819 Schottky diode (D2)
5 1N4148 silicon diodes (D3-D7)
1 3mm red LED (LED1)

Capacitors
1 100μF 25V PC electrolytic
1 4.7μF 16V tag tantalum
8 1μF 50V monolithic ceramic
1 220nF (0.22μF) 50V monolithic ceramic
2 100nF (0.1μF) 50V monolithic ceramic
1 33nF (.033μF) MKT polyester

Resistors (0.25W, 1%)

1 470kΩ	1 1.2kΩ
1 300kΩ	1 1kΩ
1 100kΩ	1 470Ω
1 22kΩ	3 220Ω
1 15kΩ	2 100Ω
2 4.7kΩ	1 51Ω (for calibration)
1 2.2kΩ	1 1Ω

Connectors & cable
1 2.5mm PC-mount DC socket (CON1)
1 9-way 90° PC-mount female 'D' connector (CON2)
2 5-way 2.54mm SIL connectors (optional) (Altronics P-5495)
1 3-way 2.54mm SIL header & jumper shunt (JP1)
9-way RS232 cable, D9M to D9F "pin-to-pin" type
100mm (approx.) length of 0.71mm tinned copper wire

provided by an on-board 9V battery or an external 6.5-12V DC source (eg, a 9V unregulated plugpack). The switch contacts in the DC socket (CON1) disconnect the battery when a jack is inserted to prevent unwanted (and potentially dangerous) charging of the battery.

Conversely, when used for in-circuit programming, the circuit is powered by the prototyping (target) board but more on that shortly.

Diode D1 affords reverse-polarity protection before the input is filtered and pumped into a low-power series-pass regulator (REG1). The LP2951 regulator used here has a very low dropout voltage and low quiescent current (75μA typical), making it an ideal choice for battery-powered operation. In conjunction with transistors Q1 & Q2, it also performs the current limiting function.

A 1Ω resistor in series with the regulator's input is used as the current sense element. We've redrawn a small section of the circuit to make its operation easier to understand – see Fig.2.

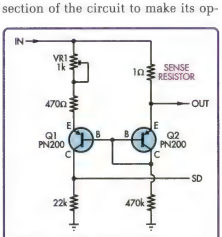


Fig.2: a small section of the diagram from Fig.1, highlighting the current mirror configuration of the Q1 & Q2 transistor pair.

As you can see, Q1 & Q2 are wired in a simple current-mirror configuration. Consequently, the voltage developed across the sense resistor in Q2's emitter leg will also be developed across the 470Ω resistor & 1kΩ potentiometer (VR1) in Q1's emitter leg.

The current flowing in Q1's emitter also flows in the collector (minus base current), so with the 22kΩ resistor shown, a voltage gain of about 22 is produced. Effectively, the circuit acts like a common base amplifier.

When the voltage drop across the sense resistor reaches 100mV (for 100mA total circuit current), the voltage on Q1's collector exceeds the threshold voltage on the regulator's SD (Shutdown) input, signalling the LP2951 to shut down.

A 220Ω resistor and 33nF capacitor between the SD input and ground provide loop compensation, ensuring high frequency stability. Potentiometer VR1 is included in the emitter circuit of Q1 to allow adjustment of the current trip point.

The LP2951 is an adjustable regulator with an output range of 1.24V – 29V. However, by connecting the SENSE, FB and VTAP pins as shown, the output is a well-regulated 5.0V.

When used for in-circuit programming, +5V is provided by the target system (CON3/4 pin 2). In this case, the power switch (S1) should be set to the "OFF" position to prevent the LP2951 from attempting to power both the programmer and the target board.

With power provided from the target board, the voltage on the regulator's output will be higher than its input voltage, which would forward-bias the internal series-pass element. Schottky diode D2 prevents this from happening, by clamping the input-output differential to less than the pass element's forward voltage.

Programming interface

The code and data memory in most of Microchip's microcontrollers can be programmed using a serial method. Microchip refers to this as "ICSP" (In-Circuit Serial Programming), and detailed information on how it works is available from their web site at **www.microchip.com** (look for the "Memory Programming Specifications" link in the "Engineer's Toolbox" section).

To understand how the programmer works, we only need a very basic knowledge of ICSP. Essentially, two port pins (RB6 & RB7 on the 16F84) take on a secondary role when in programming mode. One pin (DATA) is used for bidirectional data exchange, while the other (CLK) is used to synchronise the exchange.

The serial input/output (DATA) pin carries both commands ("erase", "program", etc) and data to and from the micro's code and data memories.

On the programming board, the DATA & CLK pins are connected to the PC's serial port DTR, CTS & RTS lines and controlled by Windows programming software. A MAX232 receiver/driver (IC1) converts the ±10V (nominal) RS232 voltage levels to logic-compatible (0-5V) levels.

IC2, a 74HC14 hex inverter, buffers and inverts the DATA and CLK signals to and from the programming socket. A 2.2kΩ resistor in series with the output of IC2a provides a simple isolation mechanism when the DATA pin is in output mode.

To enter programming mode, the micro's MCLR/VPP pin must first be driven low and then raised to the programming voltage level. Again, this is controlled by the Windows programming software via one of the PC's serial port lines (TXD).

The TXD line is first converted to TTL levels by a resistive divider and clamping diodes D6 & D7, after which it is buffered and inverted by IC2e. The output from IC2e then drives an MCLR/VPP switching circuit, comprising Q3-Q7, ZD1, D5 and a sprinkling of resistors.

VPP generation & switching

The PIC16F84/A requires a high voltage level (13V ±1V) on its MCLR/VPP pin during programming. This is generated by adding several components to IC1's existing voltage boosting circuitry.

As described earlier, IC1's primary function is to convert RS232 voltage levels to logic levels and vice-versa. With only a +5V supply rail, the MAX232 generates the higher positive and negative voltages required for RS232 communications using two internal charge-pump voltage converters.

One converter doubles the supply voltage to +10V (nominal) and the other inverts the result to obtain –10V.

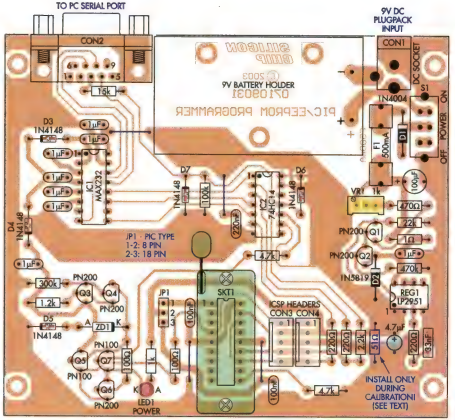


Fig.3: follow this diagram closely when assembling the PC board. Take care with the orientation of all the ICs, diodes, and the 100µF and 4.7µF capacitors. The 51Ω resistor should only be installed during the current calibration procedure.

Four external 1µF capacitors provide the necessary filtering.

By adding diodes D3 & D4 and a 1µF capacitor to pin 4, we've tapped into the MAX232's charge pump circuitry to create a voltage quadrupling circuit. However, due to switch and diode losses, the voltage appearing on D4's cathode is less than four times the supply rail, at about 17.8V.

To minimise loading on the boosting circuitry and therefore reduce battery drain, we've used a low-current voltage reference together with a series pass element to generate the nominal 13V programming voltage.

Transistors Q3 & Q4 form a simple constant current source, providing bias current for ZD1 & D5 and the base of Q5. The series combination of ZD1 & D5 clamp the base of Q5 at 13.6V, which fixes the output (emitter) of Q5 at 13V, assuming Q7 is off.

When Q7 switches on, it pulls the base or Q5 towards ground, switching it off. At the same time, Q6 switches on. This holds the MCLR/VPP signal at a logic low level and therefore any PIC in the programming socket is held in the reset state.

The totem-pole arrangement of Q5 and Q6 gives a "two-diode" drop

Main Features

- Battery (on-board) or plugpack powered
- Programs PIC16F84/A, 16F627/A, 16F628/A, 12F629 & 12F675 micros
- Programs PIC16F87X & 24CXX EEPROMS with user-wired adapters
- Serial port connected (eliminates parallel port cabling issues)
- Reverse PIC protection
- Supports in-circuit programming (limited, see text)
- Recommended software runs on Win9x, Me, NT4, 2000 & XP

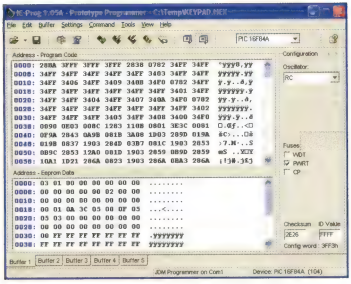


Fig.4: the main IC-Prog window. Select the PIC type from the drop-down list on the menu bar (here we've chosen the PIC16F84A) before loading the HEX file.

"dead-band", ensuring that both transistors don't conduct simultaneously during switching transitions.

Note: the (newer) PIC16F62X and 16F87X series micros do not require high voltage for programming. However, Microchip has retained support for this programming method to ensure backward compatibility. Therefore, all of these devices can be programmed using the Portable PIC Programmer.

Construction

All parts mount on a single PC board coded 07109031. Using Fig.3 as a guide, begin by installing the four wire links, followed by all the resistors and diodes. Make sure that the cathode (banded) ends of the diodes are oriented as shown.

The three sockets for IC1, IC2 and REG1 can go in next, followed by the capacitors, transistors (Q1-Q7) and potentiometer (VR1). Note that there are two transistor types (PN100 & PN200), so be careful not to mix them up!

Install the connectors, 3-pin header (JP1), fuse clips and power switch (S1) next. If you'll only be using the on-board programming socket, then there's no need to install the two ICSP headers (CON3 & CON4).

The battery holder, power LED and programming socket should be fitted last of all. Before soldering the holder in place, secure it firmly to the PC board using three No.4 x 6mm self-tapping screws.

For the programming socket, you can use either a standard IC socket or one of the (much) more expensive ZIF (Zero Insertion Force) sockets. It all depends on how often you'll be using it and how much money you want to spend. 18-pin ZIF sockets are available locally from a number of sources, including Jaycar Electronics (Cat. PI-6480).

To complete the assembly, attach four small stick-on feet to the underside of the PC board, or fit a nylon/brass tapped spacer to each corner hole. Alternatively, check out the section on housing towards the end of the article if you prefer to build the programmer into a case.

Before we move on to the programming software, let's do some basic power checks and calibrate the current limiting circuit.

Setup and testing

For the following tests, you'll need a fresh battery or a 9V DC plugpack, a 51Ω 0.25W resistor and a digital multimeter.

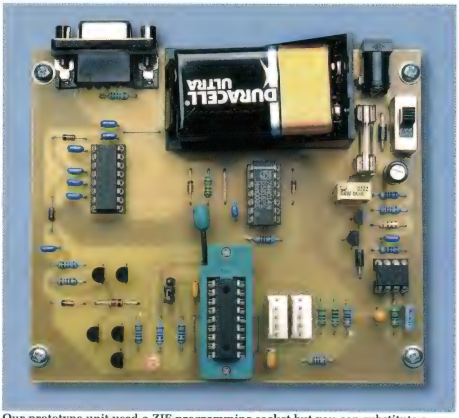
Important: do not insert a PIC in the programming socket or plug in the serial cable until these checks are complete!

All measurements are made with respect to the ground rail. Connect the negative probe of your meter to any convenient ground point, such as the cathode (banded) end of D5 or the metal body of the power switch (S1).

Adjust VR1 fully clockwise and switch on. Set your meter to read volts and check each of the following points for the voltages indicated: REG1 pin 1 (5.0V); IC1 pin 2 (+9.6V); IC1 pin 6 (-9.4V); and D4's cathode (+17.8V).

Table 1: Resistor Colour Codes

No.	Value	4-Band Code (1%)	5-Band Code (1%)
1	470kΩ	yellow violet yellow brown	yellow violet black orange brown
1	300kΩ	orange black yellow brown	orange black black orange brown
1	100kΩ	brown black yellow brown	brown black black orange brown
1	22kΩ	red red orange brown	red red black red brown
1	15kΩ	brown green orange brown	brown green black red brown
2	4.7kΩ	yellow violet red brown	yellow violet black brown brown
1	2.2kΩ	red red red brown	red red black brown brown
1	1.2kΩ	brown red red brown	brown red black brown brown
1	1kΩ	brown black red brown	brown black black brown brown
1	470Ω	yellow violet brown brown	yellow violet black black brown
3	220Ω	red red brown brown	red red black black brown
2	100Ω	brown black brown brown	brown black black black brown
1	51Ω	green brown black brown	green brown black gold brown
1	1Ω	brown black gold gold	brown black black silver brown



Our prototype unit used a ZIF programming socket but you can substitute a standard IC socket if the unit is intended for occasional use only and you want to save money.

If all measurements check out, then power off and install the 51Ω resistor across the +5V and ground rails. If you have a ZIF socket, this can be achieved by slipping the resistor into pins 5 (VSS) and 14 (VDD) of the socket and closing the gate. Be sure to fit a jumper shunt on JP1 (pins 2-3) to route VDD to pin 14 of the socket.

Alternatively, if you're using a standard IC socket, then temporarily solder the resistor into the "calibration" position marked on the overlay diagram (Fig.3).

That done, power up and slowly wind VR1 in an anticlockwise direction while monitoring the +5V rail. At some point, you should note that the voltage starts to decrease. Now reverse direction, winding the pot in a clockwise direction until the voltage reading is just restored to its maximum value.

This sets the maximum power supply current to approximately 100mA. About 15mA is consumed by the on-board circuits, leaving 85mA for the programming socket. Now if a PIC is accidentally reversed in the socket (or a faulty PIC is inserted), nothing bad should happen!

Now switch off and remove the 51Ω resistor. The calibration is now complete, so let's move on to the PC side of things and install the Windows programming software.

Installing the software

The PC interface side of our programmer is compatible with the well-known Ludipipo/JDM serial PIC programmers. This means that it can be used with much of the free programming software available on the Internet.

In keeping with several recent articles on PIC programming, we've selected IC-Prog for the job, as it can program all the devices of interest and it runs on all recent versions of Windows.

You can obtain the latest version of IC-Prog from **www.ic-prog.com**. In all, you'll need to download three files; the application (icprog105a.zip), the driver for Windows NT/2000/XP (icprog_driver.zip) and the help file (icprog.chm). Note that the filenames will change over time as IC-Prog is improved and updated.

Unlike most Windows applications, IC-Prog is not self-installing, so you'll

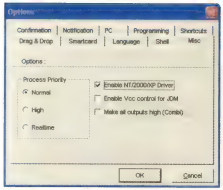


Fig.5: Windows NT/2000/XP users can enable the built-in I/O port driver on this tab. Do not change any other settings here!

Fig.6: if you get this message when IC-Prog starts, it means that the I/O port driver is not properly installed.

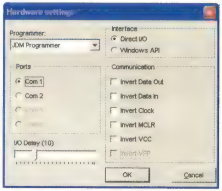


Fig.7: select the "JDM" type programmer on the "Hardware Settings" tab. The I/O Delay slider is generally OK at the default setting but can be increased if you get the occasional verify error. Do not enable (check) any of the "Invert signal" options!

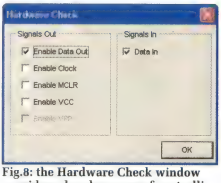


Fig.8: the Hardware Check window provides a handy means of controlling the interface lines for fault-finding.

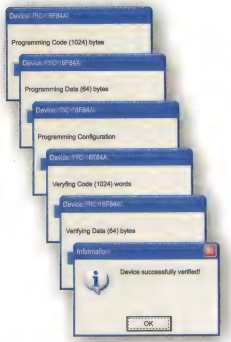


Fig.9: after you hit the "Program All' button, IC-Prog automatically erases, programs and verifies code, data and configuration (fuse) memory. If the CP (code protect) fuse bit is set, the verify will fail.

need to manually create a folder to contain the files. We named ours "C:\IC-Prog". It's then just a matter of unzipping the first two files into the new directory and creating a shortcut on your desktop (or start menu) to "icprog.exe".

The help file (icprog.chm) should also be saved in this new folder.

Installing the port driver

For Windows NT/2000/XP users, the serial/parallel port driver should be installed as the next step. Before continuing, refer to the "I/O Port Access on Windows NT/2000/XP" panel elsewhere in this article.

Launch IC-Prog (ignore any error messages) and from the main menu select *Settings -> Options*. Click on the *Misc* tab and from the list of displayed options (Fig.5), click on the "Enable NT/2000/XP Driver" check box (do not change any other settings on this tab!). Follow the prompts to restart IC-Prog and complete the installation.

Note: you need to be logged in as "Administrator" (or equivalent) when installing the driver. If the installation is unsuccessful, you will get a "Privileged Instruction" error whenever IC-Prog attempts to access the serial port.

Before use, IC-Prog must be set up to suit the programming hardware. Let's do that next.

Setting up IC-Prog

From the main menu, select *Settings -> Hardware* to bring up the "Hardware Settings" dialog (see Fig.7). Choose "JDM" as the programmer type and "Direct I/O" as the interface method. You should also select the COM port that you'll be using with the programmer. No other settings in this dialog should be changed (do not check any of the "invert signal" options!).

To prepare for the next step, connect your programmer to the chosen serial port using a 9-way "pin-to-pin" RS232 cable and power up.

VPP check

Before programming your first PIC, it's a good idea to check that the programming voltage (VPP) level is correct. We weren't able to do this during the setup and test procedure because the MCLR/VPP switch (Q7) is on by default, disabling the 13V regulator.

IC-Prog includes a handy debugging dialog that enables us to switch on the programming voltage. Select *Settings -> Hardware Check* from the main menu to bring up the "Hardware Check" window (Fig.8).

Click in the "Enable MCLR" box to switch off Q7 and enable the 13V regulator. Now measure the voltage at pin 4 of the programming socket. If all is well, your measurement should be close to 13.0V.

By the way, clicking in the "Enable Data Out" box should cause a corresponding tick to appear in the "Data In" box. This is because "Data Out" (DTR) is looped back to "Data In" (CTS) on the programmer. It's a handy way of checking that the software is communicating with your programmer.

Assuming your programmer has checked out OK, close the "Hardware Check" window and reach for that bag of blank PICs!

Acid test

To program a PIC, first select the appropriate device type from the drop-down list on the main menu bar – see Fig.4. That done, load the program/data file that you wish to write via the *File -> Open File* menu. The contents of the file will now appear in the "Program Code" and "EEPROM Data" frames.

Next, switch off and insert your PIC in the programming socket. Both 8-pin and 18-pin devices go in with pin 1 aligned as shown on the overlay diagram (Fig.3). For 8-pin devices, install a jumper shunt on JP1 pins 1-2,

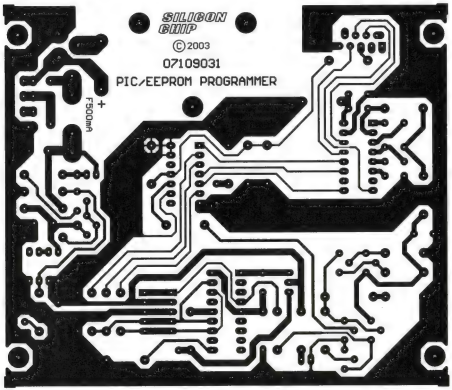


Fig.10: this is the full-size etching pattern for the PC board.

whereas for 18-pin devices, jumper pins 2-3.

Now power up the board and click on the "Program All" button. If programming fails, erase the device (click on the "Erase All" button) and try again. By default, the device is automatically verified both during and after programming. If desired, you can change this action via the *Programming* tab, accessible from the *Settings -> Options* menu.

Caution!

If you're about to program either a PIC12F629 or PIC12F675, then beware! The internal oscillator and bandgap reference are factory calibrated and the results saved on-board. When you erase/program the device, these values are overwritten!

Before erasing or programming the device for the first time, perform a memory read and record the bandgap fuse settings and OSCCAL value for future reference. The OSCCAL value is stored in the last location of code memory (03FF). Refer to the Microchip datasheets for more information.

In-circuit programming

For faster development, it's possible to connect the programmer to your prototyping board. Then each time you want to test a modification to your code, there's no need to unplug the PIC chip to reprogram it.

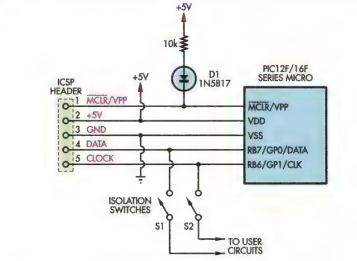
An ICSP header (CON3/4) is provided on the programmer for the connection. Fig.11 shows the additional circuitry that you'll need to include on your prototyping board to support ICSP.

To prevent the ICSP signals from being loaded down by the circuits that would normally be connected to the PIC's RB6 & RB7 port pins, these two lines must be isolated during programming. The easiest way of achieving this is with switches or jumpers.

Also, note that the high voltage present on the MCLR/VPP line during programming must be isolated from the prototype board's +5V rail with a Schottky diode. Use a 10kΩ (or larger) pull-up resistor for your power-on reset (MCLR) circuit.

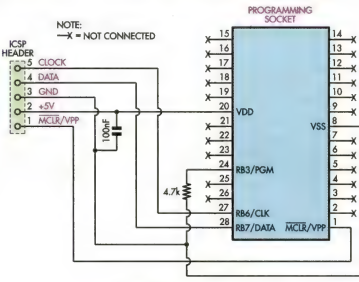
The cable between the programmer and your prototype board must be no longer than 150mm to ensure reliable operation.

In ICSP mode, +5V power for the programmer is derived from the prototyping board. This means that you need to power off your prototyping board before connecting and disconnecting the ICSP cable. It also means that the programmer's power switch (S1) should remain in the "OFF" posi-



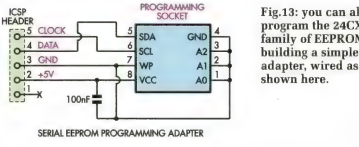
ICSP CONNECTION ON PROTOTYPING BOARD

Fig.11: to program PICs in-circuit, include a 5-way header on your prototyping board for connection to the programmer. Switches S1 & S2 and diode D1 isolate the ICSP signals during programming.



PIC16F873/876 PROGRAMMING ADAPTER

Fig.12: you can easily expand the programmer to handle 28-pin & 40-pin flash-based PICs. Here we show how to wire up a 28-pin socket for the PIC16F873/876 devices.



SERIAL EEPROM PROGRAMMING ADAPTER

Fig.13: you can also program the 24CXX family of EEPROMs by building a simple adapter, wired as shown here.

I/O Port Access In Windows NT/2000/XP

The I/O (Input/Output) ports present on most PCs provide a simple means of connecting and controlling just about any type of external device.

To simplify design (and save money), many of these external devices rely on the PC's horsepower to do all the work. Often, this means that external hardware can be reduced to just a few transistors or logic gates.

You might be surprised to learn that controlling "dumb" devices like these can be quite a challenge even for today's super micros. Windows operating systems are "event driven", meaning that they do not work well with devices that need to be controlled in "real time". Simple PIC and EEPROM programmers fall into this category.

To get around this problem, software engineers often bypass the Windows operating system altogether and access the I/O port hardware directly. This method works well under Windows 95/98 and earlier Microsoft operating systems.

However, Microsoft "shut the door" in Windows NT, 2000 & XP, making it impossible to (legitimately) access the ports directly. This was done to improve the integrity and security of Windows. Nevertheless, on a stand-alone machine in a development (home, workshop, etc) environment, this level of security can be a pain in the proverbial.

Note: for direct I/O access, the hardware must be connected to the PC's ISA bus. The standard serial and parallel ports on most motherboards are ISA bus-connected. Conversely, add-on serial or parallel port cards that plug into a PCI slot are not. PCI-connected ports require special Windows drivers and therefore won't work with the direct I/O methods (or port drivers) described here.

Faking it

Not surprisingly, a number of programmers have written port drivers that circumvent the Windows protection schemes, restoring direct port access capability to user mode programs. This allows much of the legacy hardware and software to continue to work on the latest operating systems. It also allows enthusiasts like us to continue experimenting with our simple port-controlled gizmos!

IC-Prog port driver

IC-Prog includes a built-in port driver than enables direct serial (and parallel) port access. However, if you don't want to install this driver, then you can still use the software by selecting the "Windows API" option in the "Hardware Settings" dialog.

As you've probably guessed, The "Windows API" option forces IC-Prog to access the serial port indirectly (via Windows). The downside to this is slower and less reliable device programming.

Port driver compatibility

Generally, once a direct I/O port driver is installed, it operates transparently, granting "carte blanche" access to any application that requests it. It's up to you to make sure that you don't try to access the same port from two different applications!

While testing our prototype, we noticed that one MS-DOS program (Autotrax) stopped responding to mouse & keyboard input when IC-Prog's port driver was installed. In the unlikely event that you experience this problem, then you'll need to uninstall the driver. This can be achieved by simply removing the tick from the "Enable NT/2000/XP Driver" check box and restarting Windows.

You can then either use the "Windows API" option mentioned above or opt for a different port driver. We found two that appear to work fine with IC-Prog and MS-DOS programs, as well as other programs requiring direct port access. These are:

(1.) UserPort, written by Tomas Franzon and available from:
www.embeddedtronics.com/design&ideas.html

(2.) PortTalk, written by Craig Peacock and available from:
www.beyondlogic.org/porttalk/porttalk.htm

Follow the instructions in the "UserPort.pdf" document (included in the ZIP file) to install it. Note that the default port settings must be changed to suit your setup.

Fig.14 shows the correct I/O address ranges for COM1 (top) through to COM4 (bottom). For example, if your programmer is connected to COM2, you'd enter only the second address range (2F8 – 2FF) and remove all the others.

Of the two drivers, we prefer PortTalk because it allows you to restrict access to specific programs. To install it, unzip "porttalk22.zip" into a temporary directory and copy "allowio.exe", "porttalk.sys" and "uninstall.exe" into your IC-Prog folder.

You'd then use "allowio.exe" to

tion if a battery or plugpack is connected.

Faster programming

To speed development work even further, check out IC-Prog's command line options. If you're continually rebuilding the same project, then there's no need to open IC-Prog and manually perform the reprogramming steps each time. Instead, create a batch file (or shortcut on your desktop) with the necessary command.

For example, the following command line could be used to program a PIC16F84A with "test.hex":

icprog.exe -ltest.hex -t104 -p -i -q

A full description of all the command line options can be found in the on-line help, accessible from IC-Prog's main menu bar.

Programming other devices

Your new programmer can also program the larger PIC16F8XX devices, as well as most of the 24CXX serial EEPROM family. However, you'll need to wire up separate adapters for the job.

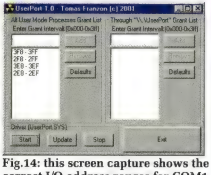


Fig.14: this screen capture shows the correct I/O address ranges for COM1 (top) through to COM4 (bottom)

grant IC-Prog access to the appropriate COM port. For example, if your programmer were connected to COM2, you'd launch IC-Prog with the following command line:

allowio.exe icprog.exe 0x2F8

To make life easier, place a shortcut to "allowio.exe" on your desktop. Right-click on the shortcut and choose "Properties" from the context menu. On the "Shortcut" tab, edit the "Target" box to include the above arguments.

Refer to the "PortTalk.pdf" document (included in the ZIP file) for more information.

Note: we emphasise that you do not need to download and install either of these drivers unless you experience problems with MS-DOS programs after enabling IC-Prog's built-in driver.

Be sure that you have completely uninstalled one port driver before installing another! Uninstalling IC-Prog's built-in driver is as simple as removing the tick from the "Enable NT/2000/XP Port Driver" check box and restarting Windows.

We do not recommend the use of any of these direct I/O port drivers in an industrial or military setting or any other application that demands high integrity and/or security.

PIC16F627A/8A Fuse Bits

The current version of IC-Prog (1.05a) does not list the 16F627A or 16F628A as supported devices. Undoubtedly, they will be included in a future release.

In the meantime, the "A" part can be successfully programmed by selecting the 16F627 and 16F628 entries. The main difference between the "A" and "non-A" parts (from a programming perspective) can be seen in the fuse bit assignments.

Fuse bits defined in your code should read in OK and not need any modification. If you're modifying them manually in IC-Prog, then note the following:

(1). The 16F627/8 has more code protection bits than the 16F627A/8A. To code protect an "A" part, select the entire memory range. For the 16F627A, choose "CP 0000h-03FFh" and for a 16F628A, choose "CP 0000h-07FFh"

(2). Fuse bit 6 is named "BODEN" on the 16F627/8 and "BOREN" on the 16F627A/8A but it is functionally identical.

(3). "ER" oscillator mode on the 16F627/8 has been redefined as "RC" oscillator mode on the 16F627A/8A. In other words, choose "ER" mode if you want the "RC" mode.

Fig.12 shows the connections required for the 28-pin PIC16F873/876 devices. A similar scheme can be employed for the 40-pin PIC16F874/877 devices.

Fig.13 shows the connections for 24CXX serial EEPROMS. This supports the 24C01, 02, 04, 08, 16, 32, 64, 128, 256 & 512 devices. Both "C" and "LC" varieties are supported.

The adapters can be wired up on a small piece of Veroboard, which is then connected to one of the programmer's ICSP headers (CON3/4). As before, the cable length must be restricted to 150mm for reliable operation.

About PIC12C508/9 micros

Undoubtedly, some would-be constructors will want to know if this project can program the 12C508 & 12C509 devices. These have been popular amongst the gaming community over recent years for Playstation "modchips" and the like.

The short answer is "yes" but results are not guaranteed. To understand why, a little background information is required.

PIC micros with a "C" in the type number can not be electrically erased. In fact, unless they have a quartz window, they're OTP (One Time Programmable) only.

In addition, unlike the "F" series chips, they don't generate their own on-chip programming voltage. This might sound like an odd statement, considering that the programmer applies 13V to the MCLR/VPP pin on the "F" series chips during programming. However, on the "F" series, this voltage is used only as a bias source, with just 200µA (max.) leakage current flowing into the pin.

By contrast, the "C" series chips require 13V at 50mA (max.) on the MCLR/VPP pin during programming. This far exceeds the capabilities of the Portable PIC Programmer, which we've designed for low-power operation.

In use, our tests revealed that actual current requirements are much more modest, at around 5-10mA. Although (in theory) this still exceeds the programmer's limit, it was able to successfully program all the blank 12C508s we had on hand.

Housing

To save money and simplify construction, the programmer does not need to be built into a case. You may prefer it in the "naked" form anyway, so that you can show off your handiwork!

Nevertheless, we've sized the board so that it will fit into a regular 140 x 110 x 35mm (W x D x H) slimline instrument case or similar.

Of course, the programming socket and power switch will need to be moved off the board for accessibility. One way of achieving this might be to wire up a small "carrier" board for the programming socket, which could then be mounted directly on the top or front of the case.

You can use one of the ICSP headers (CON3/4) for the connection back to the main board. Just remember to keep the cable length to 150mm or less for reliable operation.

Note that as shown on the circuit diagram (Fig.1), a 4.7kΩ pull-down resistor must be connected between pin 10 of the socket and ground. In addition, connect a 100nF decoupling capacitor directly across the supply (VDD & VSS) pins. **SC**

CIRCUIT NOTEBOOK

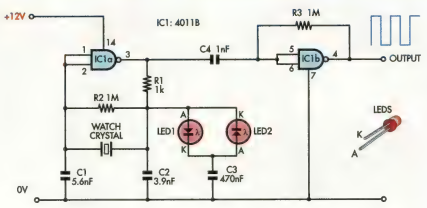
Interesting circuit ideas which we have checked but not built and tested. Contributions from readers are welcome and will be paid for at standard rates.

"Safe" oscillator for watch crystals

This circuit was developed to allow watch crystals to be used in an existing CMOS oscillator circuit that was to run from a 12V supply.

The problem is that these crystals only work up to a supply voltage of about 6V. Any more than that and the crystal will be over-driven, causing it to shatter.

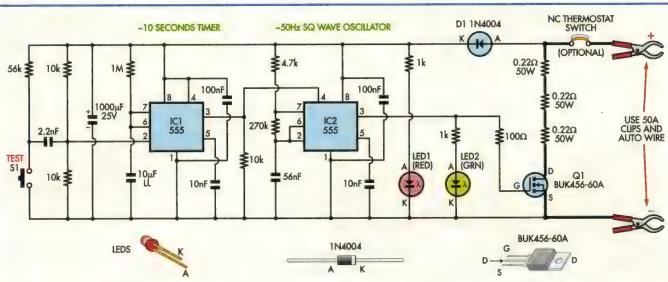
This circuit solves the problem by using LEDs 1 & 2 and a 470nF capacitor (C3) to limit the drive to the crystal to about 4V peak-to-peak. Note that it may be necessary to adjust C1 & C2 to ensure reliable start-up and stable oscillation with some crystals. However, the C1:C2 ratio should be maintained.



As a bonus, the two LEDs both glow, giving a visual indication that the oscillator is working.

Duncan Graham, Hamilton, NZ. ($35)

Editor's note: the relatively high values used here for capacitors C1 & C2 will load the crystal, which means that the oscillator will run at less than the nominal crystal frequency (32.768kHz).



Internal resistance tester for batteries

This circuit is designed to check the condition of lead-acid and gel cell batteries with capacities greater than 20Ah. It switches a load of about 18A at a rate close to 50Hz so that the internal resistance of the battery can be measured using a digital multimeter across the battery terminals.

The measured AC voltage in millivolts divided by 10 (ie, a shift of the decimal point) is approximately equal to the battery's internal resistance in milliohms.

As shown, the circuit is quite straightforward and is based on two 555 timer ICs (IC1 & IC2) and power Mosfet Q1. IC1 operates as a monostable timer with a period of 10s. When switch S1 (Test) is pressed, IC1's pin 3 output goes high for 10s and this enables IC2 which operates as a 50Hz astable oscillator.

IC2 in turn drives power Mosfet Q1 which is connected across the load in series with three 0.22Ω 50W resistors. IC2 then turns off again after 10s – ie, at the end of the monostable timing period.

LED1 provides power indication when the circuit is connected to a battery, while LED2 (green) comes

Pendulum-controlled clock

Here's how to build a pendulum-controlled clock which can be made really accurate. Retro? – yes, but an interesting project all the same.

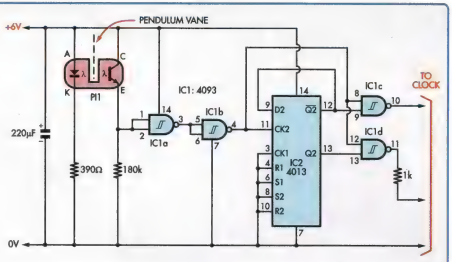
You'll need a spare quartz clock which must be adapted by first isolating the two pads on the chip which lead to the coil. You then have to connect wires to these pads and feed them out through a hole in the case (see SILICON CHIP, December 1996, p38, for full instructions, or October 2001, p37, for brief notes.) You'll also need a spare battery driven pendulum from another, or the same, clock.

As originally used, these pendulums are for appearance only and play no role in timekeeping. The salvaged unit should be mounted on a substantial vertical backboard. You'll find that the pendulum swings pretty fast and it must be slowed down by adding weights near the lower end.

However, it's not the mass of a pendulum that controls its rate – instead, it's the distance from the support to the centre of mass that counts.

The aim is to make the pendulum operate so that it takes exactly 1s for a full "to and fro" swing – ie, 0.5s "beats". Fine adjustment on mine was made by adding an adjustable (up and down) weight to the pendulum rod. This consisted of a small G-clamp fabricated from a brass strip and held by a small screw.

At the bottom end of the pendulum attach an inverted T-shape aluminium vane, about 10mm wide and as thin as possible. This should be painted black.



This vane is used to trigger a photo-interrupter which is attached to the backboard. The lengths of the arms of the "T" are made so that when the pendulum swings one way, the interrupter triggers – ie, the light is no longer blocked. Conversely, when the pendulum swings the other way, the vane must continue to interrupt the light.

This means that, with the pendulum swinging in 0.5s beats, we get a short pulse from the photo-interrupter at 1s intervals. This pulse is inverted by IC1a and inverted again by IC1b which then clocks IC2, a 4013 flipflop.

IC2 alternately produces 1s-long pulses at its pin 12 & 13 outputs. These outputs are then fed to IC1c & IC1d respectively, where they are gated by the short pulses on pin 4 of IC1b. This produces two short pulses to drive the clock in alternate directions at 1s intervals. And that's all you need to drive the clock.

Alternatively, this circuit could be a master clock and could be used to drive several slaves, all remaining in time. And model train enthusiasts could drill one or more holes in the vane to make their "railway" clocks run at what ever speed they need.

The circuit can be built on a small piece of strip board. Note that the photo-interrupter should be mounted with the photocell facing the backboard. This minimises the risk of interference by ambient light. The photo-interrupter is available from Jaycar – Cat.ZD 1901.

A footnote for horologists – if you have a clock with a Hipp butterfly escapement, you could rid yourself of the trailing arm and contact arrangement and replace it with a vane and photo-interrupter set so that as the arc of the swing becomes too small, a pulse is missed. This could then be detected by a 555 missing pulse detector circuit which would then energise the impulsing magnet.

A.J Lowe,
Bardon, Qld. ($50)

on during the test period. The thermostat is not necessary unless the unit is to be used repeatedly (the Jaycar ST-3823 70°C unit is suitable) and you want to protect the output circuit against overheating.

Note that the power Mosfet does not need cooling but the thermostat and the 0.22Ω 50W resistors should all be mounted on an aluminium heatsink at least 2mm thick.

In practice, the internal resistance of car batteries can vary from about 15mΩ down to about 3mΩ. Before testing the battery, check that the electrolyte level is correct and that the voltage across its posts exceeds 12.5V for a nominal 12V battery; ie, close to full charge.

That done, switch on the car's headlights and measure the DC voltage between each battery post and its connecting terminal. It should be less than 10mV in both cases; if not, the terminals need cleaning.

Victor Erdstein is one recipient's winning of the Peak Atlas LCR Meter.

Once you've done that, you can turn off the headlights, connect the tester and proceed with the internal resistance test. Be sure to connect the multimeter's test probes directly to the battery posts, to read the internal resistance (not the battery terminals).

Victor Erdstein,
Highett, Vic.

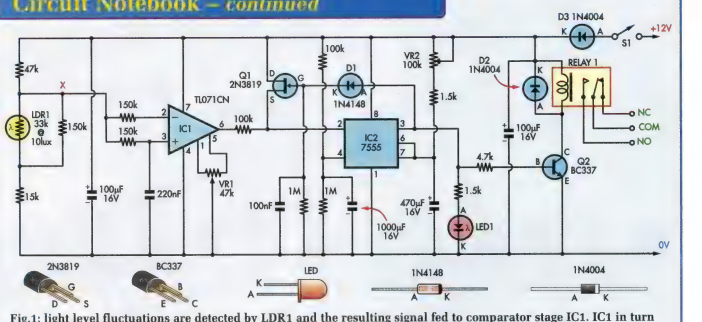


Fig.1: light level fluctuations are detected by LDR1 and the resulting signal fed to comparator stage IC1. IC1 in turn triggers 7555 timer IC2 which is wired as a monostable and this drives transistor Q2 and a relay.

Super light sensor circuit

This "Super Light Sensor" responds to minute fluctuations in light level, auto-adjusting over the range from about 200 lux up to 60,000 lux (ie, from a modestly lit room to direct sunlight). It has lots of potential uses – eg, detecting a car entering a driveway, a person moving in a room, or wind rustling the leaves of a tree. At the same time, it has a high level of rejection of natural light variations, such as sunrise, sunset and the movement of clouds.

While it is a "passive" system, it can also be used as an "active" system – ie, used in conjunction with a light beam. Its great advantage here is that, since it responds to fluctuations in light level rather than the crossing of a specific light threshold, it is much more flexible than other typical "active" systems. It can be placed within the line-of-sight of almost any light source, including "vague" ambient light, and simply switched on.

As shown, the LDR is wired as part of a voltage divider so that, between darkness and full sunlight, its output at "X" varies between about one-quarter and three-quarters of the supply voltage. A wide variety of sensors may be used in place of the LDR, including photo-transistors, photodiodes and infra-red and ultraviolet devices.

The signal from the sensor is fed to the inputs of comparator IC1 via two 150kΩ resistors. However, any signal fluctuations will be slightly delayed on pin 3 compared to pin 2, due to the 220nF capacitor.

As a result, the pin 6 output of the comparator (IC1) switches low during short-term signal fluctuations and this triggers monostable timer IC2. IC2 in turn switches on transistor Q2 which activates Relay 1. It also lights LED1 via a 1.5kΩ current-limiting resistor. Trimpot VR2 allows the monostable period to be adjusted between about 3s and 30s.

As with all such circuits, the Super Light Sensor may not work as well under AC lighting as under natural lighting. If AC lighting does prove a problem, a 16µF (16V) electrolytic capacitor can be connected between the sensor output and ground to filter the signal to the comparator.

When pin 3 of IC2 goes high, FET Q1 also turns on and pulls pin 2 of IC2 high. This transistor remains on for a very short period after pin 3 goes low again due to the 100nF capacitor on its gate. This "blanking" is done to allow the circuit time to settle again after the relay disengages (and stops drawing current).

The "blanking" also makes it possible to run external circuits from the same power supply as the Super Light Sensor, without upsetting the circuit. The current consumption is less than 10mA on standby, so that battery operation (eg, 8 x AA batteries) is feasible.

After building the circuit, switch on and wait for the circuit to settle. It's then just a matter of adjusting VR1 so that the circuit has good sensitivity without false triggering.

With some experimentation, it's possible to set the circuit to change seamlessly from natural to AC lighting. If maximum sensitivity under natural lighting false triggers the circuit under AC, then adjust VR1 to give maximum sensitivity under AC (and vice versa).

In daylight, the Super Light Sensor will typically detect a single finger moving at a distance of 3m, without the use of any lenses. It will also detect a person crossing a path at a distance of more than 10m, again without lenses. And when used as an "active" system, it will typically detect a person walking in front of an ordinary light source (eg, a 60W incandescent light-bulb) at more than 10m.

Note that these ranges are achieved by placing the LDR (which

LED lighting for dual-filament lamps

A number of readers have asked how the bayonet lamp described in the "LED Lighting For You Car" project in March 2003 can be adapted to replace a dual filament lamp.

Before we describe how it's done, note that we recommend that the result be checked as having sufficient brightness for a stop & tail-light application. That's because the light output may be inadequate, depending on the tail-light lens and reflector assembly – so use any modified lamps with discretion!

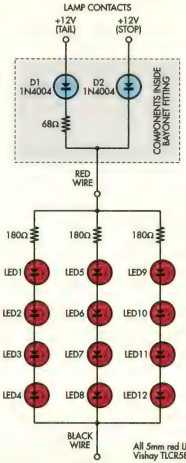
As shown, an additional diode (D1) and resistor (68Ω) provide power from the "tail" circuit. Alternatively, when the "stop" circuit is powered, the resistor is bypassed by D2, thus increasing the LED current and the light output.

Modifications to the lamp assembly instructions are as follows:

(1) After soldering in the copper tube but before soldering the platform board to the bayonet lamp base, the three components inside the dotted box must be wired up inside the base.

(2) The anode leads of the diodes can be soldered directly into the contacts ("bumps") on the base (a fine file or glass paper may be needed to get a nice round shape). Everything must be insulated (use heatshrink tubing).

The red wire from the Multidisc board is then soldered to the junction of D2 and the resistor. The black wire is soldered directly the metal casing of the lamp.



MULTIDISC LAMP CONNECTION FOR DUAL CIRCUIT FUNCTION

We suggest testing the lamp before soldering the platform board in place. It may be necessary to vary the value of the additional resistor to get the correct intensity change between stop & tail modes.

SILICON CHIP.

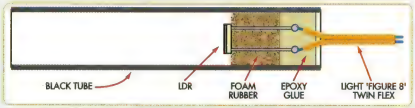


Fig.2: the LDR should be installed inside a black tube, as shown here.

is used as the light sensor) in a black tube, as shown in Fig.2. A single lens will double these distances, while the use of two lenses in an "active" system will multiply the basic range by 6 or 7.

Thomas Scarborough, Capetown, South Africa. ($50)

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SERVICEMAN'S LOG

A Matchline meets its match

Most modern sets now store fault codes in a memory buffer which is accessible via the on-screen display (OSD). But what if the OSD cannot be accessed because there is no picture?

My first story this month concerns a Philips Matchline 29PT6361/79R. This particular set was manufactured in China in 2000 and uses the A10A chassis (the Asia-Pacific successor of the A8 chassis). It is a very sophisticated, high-performance set but can suffer from intermittent faults attributable to its Small Signal Panel (SSP) or SSB (Small Signal Board) – part No. 3139 178 66780.

The SSP is not really a repairable item for the faint-hearted (such as yours truly), as it has three miniature microprocessors. However, it is possible to change the 8-pin EEPROM IC (7066 M24C32-WMN6).

YOU NEED A LOT OF SPECIAL RESOURCES & TALENT TO REPAIR THESE BABIES...

Getting back to those miniature microprocessors, IC7064 (SAA5067) is called the (ARTISTIC) PAINTER and is a control microprocessor with 100 pins. IC7301 (TDA8885) is called BOCMA and is a video microprocessor with 64 pins. And IC7651 is called MSP (for Multi-standard Sound Processor) and also has 64 pins. These are mounted on double-sided PC board measuring 150 x 100mm, along with eight other surface-mount ICs.

You need a lot of special resources and talent to repair these babies!

To find out whether the set is faulty, you can enter the SAM (Service Alignment Mode) by entering 062596 on the remote control, and then pressing the "OSD" (On Screen Display) button (marked "i+"). This mode allows you to perform alignments and change option settings.

To get into the SDM (Service Default Mode) you punch in 062596 on the remote control again, followed this time by the "Menu" button. And to get into the CSM (Customer Service Mode), you press the MUTE key and any of the top control buttons on the TV simultaneously for at least four seconds.

The opening menu will display the set's operating hours (ie, how many hours it has been on) in hexadecimal – eg, 18H = 00011011 (binary) = 27 hours (decimal) – and the Software Identification of the main microcontroller. The second line shows the Error code buffer and this contains all the errors since the last time it was cleared. To clear the buffer, you activate "CLEAR ERRORS" in the SAM menu and exit via the "STANDBY" command.

Using this tool will let you store all the errors and can help in identifying intermittent faults, even when you are not there. Each code is listed in the Service Manual (and you can ignore Code 17!).

Anyway, all this is to give some background to a nasty fault encountered by a colleague of mine. The set came in with no picture but the sound was OK. The client said that the picture had been "getting pinker" before it disappeared altogether. By turning up the screen control on the flyback transformer, the screen showed a fully scanned grey raster with retrace lines but no OSD (On Screen Display).

Because of this, it wasn't possible to check the error codes in the buffer. Not to be outdone, my colleague was fortunate enough to have another similar set in for repair which he had just completed. He swapped over the SSP and was able to read the error codes on the other TV. These were 17, 23, 7 & 6 and of these, only error code 7 was pertinent. The description for this code is "BC-loop (Black Current) not stabilised" and it lists the possible defective components as the RGB amplifier, RGB guns or the RGB driving signals of the BOCMA (BIMOS One-Chip Mid-end Architecture) high-end video input processor (IC7301).

The BC-loop is part of the CRT drive circuits. In operation, the drive to the picture tube is continuously adjusted to prevent visible aging of the CRT and give "perfect" pictures. This is called "Continuous Cathode Calibration" and is achieved by comparing and monitoring two levels (Hi and Lo) of point black level stabilisation for each gun and altering the drive accordingly. The maximum current allowed is 100µA and this is fed to pin 30 of the BOCMA IC.

Having already eliminated the SSP and BOCMA IC, my colleague was left with the CRT socket and drive assembly and possibly the beam current limiting circuitry from the flyback transformer.

By measuring the voltages on the CRT Panel Board B, he found the drive voltages from the BOCMA to the RGB amplifier (pins 1-3 of IC7830, TDA-6108Q) were all low by about 1V. In addition, the outputs to the CRT cathodes were all too high (by 50V) at 190V or so. Furthermore, the critical CUTOFF control voltage from pin 5 to pin 30 (BLKIN) of the BOCMA (Black Current Loop) measured 7V instead of 5.6V.

All the other voltages were substantially correct (considering there was a fault). My colleague replaced the IC but it made no difference. He then did a blanket check of all the pertinent components on the board (obviously not the additional parts involved with the SCAVEM circuit) with his digital multimeter but nothing showed up. By now, he was beginning to suspect the picture tube.

Next, he checked the signals with an oscilloscope. He found that RGB waveforms were arriving at the IC but nothing was going out to the cathodes.

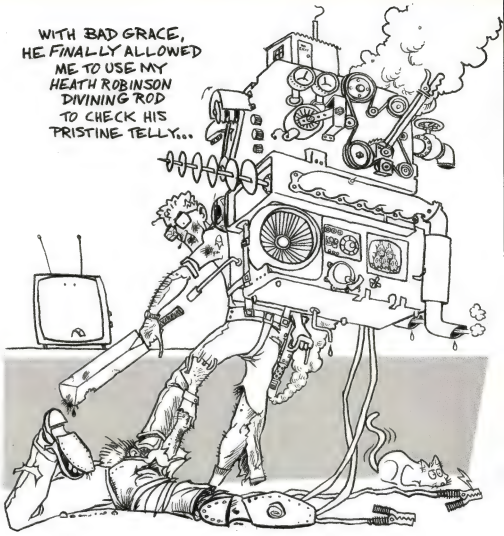
My colleague then removed the CRT socket from the tube and re-measured the waveforms. They were now all reaching the cathode pins (8, 6 and 11). Finally, he found that pins 11 (blue cathode) and 12 (GND) on the CRT socket were short circuit.

That was when he asked me for my opinion. He was 99% sure that there was a cathode short inside the picture tube which, because of the cost, meant that this set would have to be scrapped.

First, I measured the CRT aquadag voltage to be about 12V and this is about what I would expect from a Philips TV with beam limiting. Next, I did my non-recommended method of checking CRTs (much to my colleague's disdain and concern for his new video output IC) – that is, I momentarily shorted each cathode in turn to ground. This gave intense colours for each gun.

I told my colleague that I thought that the CRT was probably OK and that I would bring my CRT analyser in the next day to confirm this. His response was "Well, what about the undoubted short inside the CRT gun?" but I didn't have an answer for this.

The next day, I brought in my ancient SWE-Check CRT analyser (OK, so all three of us are old). My colleague laughed when he saw this prehistoric piece of apparatus and nearly wouldn't let me put it on this 2-year old TV. I assured him that all I was going to do was check the emission and for shorts and promised not to blow the CRT up.



With bad grace, he finally allowed me to use my Heath Robertson "divining-rod" to check his pristine telly. Anyway, the good old SWE-Check analyser with the modified adaptor I had made showed there were no shorts at all and that the emission was excellent on all three guns. The cut-offs were spot on too and this was the same at 6.3V, 7.3V and 9V true RMS on the heaters (I wasn't game to go higher)!

My colleague still wasn't convinced, however, and pointed to the undeniable short on the CRT. I examined this very carefully and noticed that the short was deliberately welded inside the gun! Finally, it dawned on me what we were doing was wrong.

We were measuring the two adjacent pins on the righthand end of the tube socket which, when compared to the PC pattern for the CRT socket, looked as though they were pins 11 & 12. However, they were in fact pins 12 & 13, although the latter is not marked on the PC board. These are indeed

Items Covered This Month

- Philips Matchline 29PT6361/79R TV set (A10A chassis).
- Sanyo CPP3002-00 TV set (A3-A4 Series).
- Hitachi C28-P500R TV set (G7P chassis).
- Philips 33FL1880/79R TV set.
- Philips 21PT118A Anubis SF TV set.
- Panasonic TC33AV1 TV set (M16M chassis).

NOW SPENDS HER DAYS LIVING IN A "MATCHBOX" WITH AN ANCIENT SANYO...

both grounded and if we had thought about, it would be impossible for the blue cathode to measure +190V if it was indeed grounded!

Finally, to prove it wasn't the picture tube, my colleague plugged the suspect CRT into another working TV's circuits by placing the two sets back to back. And that finally proved that the picture tube was indeed perfect when it produced a good picture.

So where did that leave my colleague? Well, he wasn't able to substitute the CRT socket board (B) as none of the other sets he had at his disposal was identical. He had eliminated the SSP and the CRT and measured everything else, so having "done my bit", I left him to solve the puzzle.

Three days later I returned to find that the set had been fixed and returned to its owner. My colleague proudly showed me the offending part, a tiny glass diode (BAV21, D6633) from the CRT board. This diode is a clamp between the +200V supply and the green cathode.

"Well", I said, "how come you missed this when you did the first cold check of the CRT panel?" He gave it to me to measure, confident that it would check out OK.

Well, of course, I upset him because I produced my old Excalibur – my ancient analog meter which uses a 9V battery. It clearly showed the diode to be leaky in both directions (75kΩ) on the 100kΩ range. He then showed me how he had measured it originally, using the diode checker range on his "U-Beaut" DVM – it quite clearly measured OK on this range.

My colleague only discovered that it was in fact faulty when he later rechecked the part out of circuit on the high ohms range of his DVM. I think the world is just getting too high-tech for its own good!

The ancient Sanyo

Mrs Eva Ruddock is an elderly widow and thanks to a lifetime of paying taxes, now spends her days living in a "matchbox". Her telly is an ancient 34cm Sanyo CPP3002-00 (A3-A4 Series) and doesn't even sport a remote control! However, Eva reckons that she doesn't need a remote, as her room is so small!

Anyway, her beloved telly died the other day and she wheeled it all the way up to our workshop and asked me ever-so-nicely if I wouldn't mind fixing it.

Now, how could I say no? The set wasn't worth fixing but it was obvious that she really couldn't afford a new one. I told her I would see what could be done – what the hell, how hard could it be to fix this? It wasn't exactly the latest in high technology and that should make it easy!

And so I stuck it on my workbench and checked it out. There was no picture but the sound and On Screen Display, both on TV and AV input, were fine – all I was missing were luminance and chrominance.

This set uses two large ICs – a microprocessor and a jungle IC (IC101, LA7680). A check with the oscilloscope showed that plenty of luminance was arriving at pin 38, chrominance at pin 40 and sync signal to pin 33. However, nothing was coming out of pins 24 (Y), 23 (B-Y), 22 (G-Y) and 21 (G-Y). I also checked that the +9V rail was on pins 11 & 13 (Vcc).

When I fiddled with a pot at the rear of the set marked "Video Amp", I noticed that the set would occasionally produce a poor negative-looking picture on the screen in TV mode, with no horizontal or vertical sync. Unfortunately, I didn't have an accu-

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rate circuit for this set. However, I did have a poor photocopy of a later version (CPP 3012) but this has a lot of extra circuits that the CPP 3002 doesn't have.

However, I had repaired dozens of these sets over the years so why would I need any help?

I started checking for the more common faults, starting with the main B1 rail which was spot on at +130V. I then checked favourites such as R232 (Beam Limiting), D801, D731, R452, C402, C401, C232 and C233. That done, I measured all the voltages around IC101 and got involved in all sorts of mental anguish when I discovered that the voltage on pin 30 was considerably less than 7V.

I finally got over this "furphy" when I discovered that I could raise this voltage by playing around with the video input (besides which, in this model, it is only connected to R422 and C424 and these were OK).

At this stage, I couldn't make my mind up as to which area the fault might be in. Was the no picture due to no sync or the no sync due to no picture? Unfortunately, the block diagram inside the jungle IC was almost illegible and not very accurate.

Using an oscilloscope, I established that the line pulses on pin 26 from the flyback transformer and the vertical timebase were spot on. And there were horizontal and vertical pulses arriving at the microprocessor (IC701). I even got out the frequency counter and checked the crystals.

This was now getting incredibly frustrating. This was meant to be an easy repair on a well-known set that was now worth nothing. But damn it all – it was now eating at my pride and I really wanted to know what it was that was beating me.

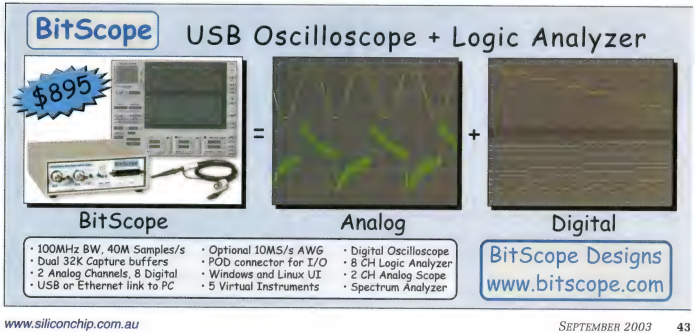
Having tried the proper "high-tech" approach with meters, oscilloscopes and frequency counters – not to mention capacitance meters – I decided to try the old wet finger trick which, I should emphasise, you should never try yourself unless you are experienced and know exactly what you are doing (get it wrong and you might need repairing as well!). Anyway, I ran a wet finger up and down between pins 40 & 25 of IC101 (the maximum voltage here is only 9V) to see if any difference could be observed. And would you believe it, one wet serviceman's pinkie on pin 33 (only) resulted in a perfect colour picture.

Well, how could such a caveman's approach do this? It amazed me too, so I tried to substituting an electronic component for my finger. The "equivalent" turned out to be a 100kΩ resistor from pin 33 to ground!

After reconnecting the CRO and monitoring the sync input to this pin, I realised that all I doing was attenuating the voltage input a fraction. The voltage should be about 7V but this unit gave 7.2V without the resistor and 6.7V with the resistor in place.

Armed with this information, I went back to the video input divider circuit to the IC and found that R200 (10kΩ) was open circuit. I felt sure that this was the culprit and replaced it but it only made a very marginal difference and the old wet finger still gave the best result – and I wasn't about to donate that to my client!

Working back along the circuit, I eventually came to a video emitter



follower stage that should have had 6V on its emitter. However, it was reading 6.7V and this seemed to be the only source of bias into this circuit. The base measured high as well, while the collector read over 13.9V. This was far too high.

Tracing it back further, I found that this voltage comes from an IC regulator (IC551, 7812). I checked the input to be 15.9V, so obviously it wasn't doing its job. Replacing this IC fixed the voltage, along with the rest of the set. And that, as they say, was that.

If I had had a better service manual, I might have taken more notice of the small variations in voltages – but it should be remembered that when there is a faulty component, it can affect lots of different circuits and give erroneous voltages and waveforms. The trick is trying to decide which are the critical ones. I must admit that I didn't think a figure of 0.3V difference on pin 30 of the jungle IC would have such consequences – especially as the waveforms didn't change much.

I didn't have the heart to charge Eva and she was stoked.

A tricky Hitachi

Problems associated with no picture have to be quickly divided into those that have OSD and those that don't.

The OSD is normally sourced directly from the microprocessor character generator and requires a clock, data and vertical and horizontal pulses to generate blanking pulses. This is normally fed into the jungle IC but on some sets can go directly to the CRT panel.

Recently I had a 1988 Hitachi C28-P500R (G7P chassis) where both the jungle IC TDA3562A IC501 and the microprocessor 50442-552ST IC001 were faulty, the former giving no picture and the latter no OSD. Without OSD, it's difficult to navigate through menus unless you are very familiar with the set. In this case, the microprocessor was no longer available but because the client had had the set from new, he was sufficiently familiar with it to continue to use it.

A difficult Philips

I have had cases (Teac & Sanyo) where the vertical pulse has been distorted by a fault in the vertical timebase that has also resulted in no picture or OSD. Currently, I am tearing my hair out (again) with a perplexing Philips 33FL1880/79R which has OSD plus picture in the PIP (Picture in Picture), as well as Teletext on Channel 7, but no picture on the main screen. I have traced the signals into one IC, TDA-8443/C4 IC7395, but nothing is coming out the other end.

There are no error codes in the Service Diagnosis Mode, all pulses and waveforms into the IC are correct and the IC has been replaced. The problem is the same for AV as well as TV. I am waiting now until another set comes in and I can swap some of the modules. I suspect that the 100Hz "high-end" module may be the culprit or even possibly the 28-pin EEPROM. I'll let you know when I get to the bottom of this!

Another Philips set

When faced with a "no-picture" fault in a modern set, it can be very difficult to make a diagnosis backed up by measurements as everything is buried in large scale integrated (LSI) circuits. In fact, I have just finished a Philips 21PT118A Anubis SF set with exactly this problem.

I started at the CRT board and found that there were no signals coming in. Not wishing to repeat my colleague's mistake with the Philips Matchline, I thoroughly checked all the components before deciding that it must be a faulty jungle IC (TDA8360E, IC7225). Fortunately for me, it turned out that this was indeed the culprit, especially as the replacement wasn't cheap. **SC**

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Speaker Kit - Pair

Includes 4 woofers, 2 tweeters, 2 crossovers with polyswitches, rear terminals, ports, innerbond, and self tapping screws for mounting speakers and crossovers.

Cat. CS-2580 $589

Cabinets – Pair

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Cat. CS-2562 $379

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Industrial quality on a hobby budget! Small hobby lathes are not new, they have been European made and very expensive, or have welded frames and are flimsy. This fantastic unit has a FULL cast iron bed, frame and headstock assembly, just like industrial lathes. It bristles with safety features including a plastic chuck cover which must be down for the machine to operate. This prevents you from starting the lathe with the chuck-key in! We have not seen a product of this quality at this price. **The cutting tools, drill chuck and live centre are all usually sold extra, costing up to $150 more, but are included in the price!!!**

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Cat. TL-4000 $899

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Cat. AM-4052 $99

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Cat. MP-3028 $24.95

Animated Singing Birds Alarm Clock

The digital clock can also be set to sound on the hour, every hour. It's actually quite smart as you can also set it to sound whenever someone passes by. These birds do more than just chirp, they actually move, with animated beak and tail.

Measures: 122(L) x 113(H) x 52(D)mm.

NEW

Cat. XC-0245 $19.95

PC Infrared Remote Control Interface Kit for PC Based MP3 and DVD Players

Ref: Silicon Chip August 2003.

In conjunction with free Windows remote control software, it can be used to drive a popular DVD player (Win-DVD 4 or 5) and MP3 player (Winamp 3). These are not the only possible uses. If you are a keen programmer, it can be configured to control just about any Windows application. Kit supplied with PCB and all electronic components.

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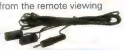
Similar in design to the AR-1832 (left), with the addition of an Infrared remote control extender. This allows you to control the DVD, Cable TV, or VCR from the remote viewing location.

NEW

PRICE BREAKTHROUGH



Cat. AR-1830 $139

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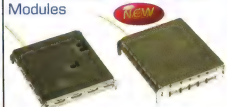
Cat. AR-1831 $89

2.4 GHz Wireless AV Sender Modules

NEW



These modules are identical to the transmitter / receiver modules used in our AR-1832 Wireless AV Sender. They are supplied in a metal case, with pin-outs and data sheets. They only require 5VDC, a few simple components, and associated panel hardware (if required) to get them up and running. The transmitter and receiver modules are sold individually for greater flexibility.

Transmitter Module

Cat. QC-3590 $34.95

Receiver Module

Cat. QC-3592 $49.95

Mini Wireless CMOS Colour Camera with Audio

NEW

Highly covert or mobile surveillance is now very accessible with the use of this 2.4 GHz camera/receiver package. Monitor remote locations up to around 100m with video and audio capture. The camera can be plugged into mains power with the included plugpack or with the 5 volt battery attachment, also included. Actual camera size is a tiny 30mm x 38mm. See Website for details and specs.

Cat. QC-3272 $269

DUE LATE SEPTEMBER

2.4 GHz Wireless CMOS Colour Camera with Audio

NEW

Simple, high quality surveillance with night vision has never been easier to install and operate. It features 12 powerful IR LED's, for excellent 'night vision' capabilities. It is housed in a rugged metal case, and can be powered from a plugpack, or 9V battery. Transmission distance up to 100m. Actual camera size is 43mm dia. See website for details.

Cat. QC-3274 $299

DUE LATE SEPTEMBER

B&W Video Door Phone with Digital Memory Function

NEW

Not only is this a video door phone, it will take a photo when someone presses the call button and store it for later viewing. You can even check to see who pressed your doorbell while you were away. The external CMOS camera is housed in a secure metal-alloy housing with Infra Red illumination. Features include a Silent Monitor feature that allows you to view the entrance area and much more. Supplied with a 10m interconnecting cable, & a plug pack power supply.

Cat. QC-3610 $499

1.3 Mega Pixel Digital Camera

NEW

Our highest resolution digital camera yet! It stores up to 26 great photos in high-quality mode and 104 in standard resolution mode. It features a 4-layer glass lens for greater image quality and a fixed focus for easy operation. The camera is simple to use, and is small enough to easily slip into your pocket or purse. See our website for full details.

Cat. QC-3194 $99

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Rotating Metal Dummy Camera

NEW

The most realistic dummy camera we have seen. In fact, it's almost identical to the real rotating camera that we do sell! It even has the IR LEDs and adjustable rotational range.
Mains plugpack supplied.

Cat. LA-5319 $89.95

High Quality Dummy Camera in Metal Case with Bracket

NEW

Give the realistic look this high quality dummy camera. With a strong mounting bracket and weather proof housing it's a heavy duty unit made to last. For added realism it has a red flashing LED (requires 2 x AA batteries not supplied). Measures: 225(L) x 80(D)mm (excluding bracket).

Cat. LA-5313 $69.95

4 Channel Digital Video Recorder with Audio and 120GB Hard Disk Drive

This full featured Digital Video Recorder will accept up to 4 video inputs, and offers a 4 way quad or switching display. It features a huge 120GB hard disk drive, which is installed in the removable case. Recording time is up to a massive 2025 hours (at 1fps, highest compression). It supports NTSC and PAL video formats, frame rate of up to 50fps, and features 4 audio inputs (1 per camera). It offers timer recording, allowing you to set up to 8 different time/date record sessions, motion detection, event recording, and much more. This is a fantastic unit, packed with features, and all at a great price. See our website for full details and specs.

- Switching or Quad Display
- 704(H) x 564(V) PAL Full Screen Resolution
- 4 Channel Audio and Video Inputs
- Video Loss Detection
- Contrast, Brightness and Colour Adjustment

Cat. QV-3067 $1,499

Digital Camera Pen

NEW

Not quite the secret agent camera, the give away is when you take a picture, the camera magically announces the shot number. Features include memory for up to 38 images, auto power off, power LED indicator and of course a twist action pen! Pictures are downloaded via the supplied RS-232 cable and viewed using the supplied software. Supplied in an attractive gift box. Compatible with Win95 or later.

BUILT IN CMOS CAMERA

Cat. QC-3380 $119.95

Both of these items are compatible with Win 95 or later

Camera in a Wrist Watch

NEW

Unbelievable as it seems, this wrist watch actually has a built in CMOS camera! It features memory for 40 images, a synthesized voice to announce the functions and number of shots taken. Watch features include stop watch, alarm, mini spot light and it even tells the time. Images are downloaded via the supplied RS-232 cable and viewed using the supplied software on CD-ROM.
Compatible with Win95 or later.

BUILT IN CMOS CAMERA

Cat. QC-3382 $119.95

Single Channel DVR with Stereo Sound & Hard Disk Drive

NEW

This full featured Digital Video Recorder offers simple front panel controls, NTSC or PAL operation, and RS-232 remote control. It is supplied with rack mounting brackets, and a 120GB hard disk drive. It can store over 2000 hours of video (at 1fps) on the supplied drive.

Also available without hard disk drive.
Cat. QV-3065, $899. See 2003 cat. for details.

Cat. QV-3066 $1,099

2.4GHz Wireless Camera Sellout

B&W CMOS Wireless Camera Transmitter/Receiver

Take the hassle out of installing surveillance cameras, simply apply power, and the camera will transmit the image and audio, to the awaiting receiver. It features Infra-red LEDs mounted on the front to "See In The Dark". Great for monitoring sleeping children, or the poolside action. Supplied with mains plugpacks, camera, 3 channel receiver, and an A/V RCA cable.

SAVE $70

Was $269

Cat. QC-3255 $199

Colour CCD Wireless Camera Transmitter/Receiver

Monitoring remote locations has never been easier or cheaper with this colour transmitting camera and 3 channel receiver. The receiver will accept up to 3 separate cameras and can be set to scan and individually display each camera. Great for home security, kindergartens, factories, surgeries etc.
Supplied is a 3 channel receiver, one transmitting camera, mains plugpacks, and an A/V RCA cable.

Limited stock! Don't miss out

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Cat. QC-3260 $229

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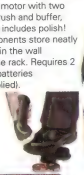
Cat. GT-3050 $19.95

Electric Shoe Polisher Kit

NEW

This kit consists of a battery operated motor with two sets of brush and buffer, and even includes polish! All components store neatly together in the wall mountable rack. Requires 2 x C size batteries (not supplied).



Cat. GH-1056 $19.95

Musical Bathtub Novelty

NEW

Your heart will go Sha-la-la-la-la as you sing along with these animated characters enjoying a vigorous bathtub romp. Great fun for the older members of the family and sure to put a smile on everyone's face. Requires 3 x AA batteries available separately.

DUE LATE SEPTEMBER

Cat. GH-1090 $24.95

Coffee Table Learning IR Remote Control

NEW

Stylish and sleek, this remote will look at home on your coffee table and will control your entire audio and visual system with ease. With five device zones, two of which hold dual selectable devices, gives you a total of seven devices you can control. It incorporates a range of keys that exceed the requirement of any ordinary AV system and you can even control your home air conditioning! See Cat Pg 301 for details •320(w) x 48(h) x 185(d)mm.

Cat. AR-1716 $179.00

Fog Machine

NEW

We have all seen fog machines in operation and know how dramatic their effects can be. It produces clouds of white fog on demand with its remote control switch. When used in conjunction with mirror balls and other party lighting, beautiful effects can be achieved. Domestic use only.

Cat. AF-1210 $89.95

1L Fog Juice

Cat. AF-1212 $9.95

Remote Controlled Fart Machine

Just hide the box near your intended victim and activate it from up to 15 metres away. Not only will they be embarrassed, they won't even know who is responsible. Great fun at home or the office with 3 different fart noises.

NEW

Cat. GH-1088 $19.95

Portable Active Plug-In Speaker

This compact and versatile speaker is great for Laptops, Walkman, Discman, MP3 players, etc. It plugs into any 3.5mm audio socket to give you amplified stereo sound. Uses 2 x 'N' Size batteries not included - use SB-2346 - pk.2

NEW

Cat. XC-9158 $19.95

Anti-Fogging Shaving Mirror with Clock

NEW

This anti-fog mirror doesn't get steamed up and has a digital clock to keep track of the time. It has in-built LEDs for extra light and is supplied with suction cup, screen hook and hanger cord.

Requires 3 x AA batteries (not supplied).

Cat. GH-1058 $34.95

4 Hr Digital Voice Recorder

This digital voice recorder will store up to 4 hours of voice quality audio in a neat, slim, hand-held unit. 4 separate message groups are available and each group can have up to 99 messages. The recorder has a VOX function and variable microphone sensitivity for voice operated recording. Includes PC software for editing sound files.

NEW

Cat. XC-0286 $169.00

A4 Magnetic Inkjet Paper

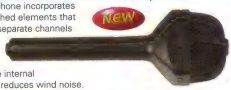
NEW

Print pictures of your family and friends and stick them on the fridge!
•Attach pictures or signs to your car, fridge etc.
•5 sheets Included
•A4 size 297 x 210mm

Cat. LM-1630 $19.95

Stereo Electret Condenser Microphone

This unique microphone incorporates two perfectly matched elements that feed two distinct, separate channels for true stereo separation. It is great for outdoor use because of the internal windscreen which reduces wind noise.



NEW

Cat. AM-4070 $39.95

Electret Condenser Boundary Microphone

NEW

A great microphone which works on the "Boundary Effect" principle. Place this microphone horizontally or vertically on a large flat surface such as a table or wall and record away. Great for stage use.

Cat. AM-4072 $44.95

Small Scrolling Message Board

Display up to a 60 character message for your family or friends, or mount this unit as a shop display drawing attention to customers. Displays 4 characters at once, scrolling through the message. Requires 3 x 'AA' batteries.

NEW

DUE LATE SEPTEMBER

Cat. XC-0190 $59.95

LED Message Board Medium Size

NEW

Great as a permanent information display for your business or shop window. Enter a message up to 60 characters long with the full keypad built in, or display one of the 26 stored messages. It can also display the time and date. Screen measures: 365(L) x 470(H). See our website for details.

Cat. XC-0192 $109.95

DUE LATE SEPTEMBER

LED Message Board Large Size

NEW

The biggest in our display board range, this unit offers the best features in a running LED display unit. Up to 60 character messages or time and date can be displayed. Entering messages is easy with the built in keypad. See our website for details.

Cat. XC-0194 $149

DUE LATE SEPTEMBER

DUE LATE SEPTEMBER

IF YOU SEE THIS SYMBOL PLEASE CALL US TO CHECK STOCK AVAILABILITY BEFORE DRIVING ACROSS TOWN.

Serial & IDE ATA HDD Cables

Serial ATA HDD Power Lead 200mm

Suits serial ATA hard disk drive

NEW

Cat. PL-0758 $8.95

Serial ATA HDD Cable 500mm

7 Pin Female to 7 Pin Female

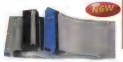
NEW

Cat. PL-0978 $9.95

Flat IDE ATA-133 Cable 450mm

Flat ribbon cable

NEW



Cat. PL-0976 $14.95

5 and 8 Port 10/100 N-Way Switches

We have negotiated a new lower price on these units, and we are passing on the savings to you! See our Catalogue page 226 for details and specs.

We have a new translucent blue coloured version available but stock may not be in all stores straight away.

5 Port
Was $99
Save $30

8 Port
Was $139
Save $50

Cat. YN-8082 $69

Cat. YN-8084 $89

Round IDE ATA - 133 Cables

NEW

The cables consist of IDC ribbon cable inside flexible PVC tubing. The use of these cables not only promotes better air flow but also tidies up the existing cabling inside your PC for easier servicing and fault finding.

DUE LATE SEPTEMBER

450mm Black — Cat. PL-0970 $21.95

600mm Blue — Cat. PL-0972 $24.95

900mm Black — Cat. PL-0974 $29.95

Clear Fan with Tri-Colour CCFL 80mm 12VDC

NEW

A great addition to your PC. It features an on/off switch and Molex power adaptors.

DUE LATE SEPTEMBER

Cat. XC-5035 $34.95

Bug Trap

NEW

A safe and hygienic method of controlling irritating insects. It works by attracting the insects with two UV lights then sucks them through its super quiet fan. Once trapped, insects dehydrate and die. Dead insects are disposed of by sliding out the removable tray. See our website for details.

Cat. YS-5542 $79.00

DUE LATE SEPTEMBER

True RMS Auto Ranging DMM

NEW

- Data Hold
- Duty Cycle
- Relative Measurement
- Frequency
- Capacitance
- 40M Ohm Resistance
- Temperature
- Holster Included

This great new meter offers true RMS measurement and a host of other great features. Excellent value for money.

Cat. QH-1536 $89.95

4 Port Broadband Router

This broadband router incorporates both LAN and WAN support and is an ideal solution for connecting small networks to the internet via high speed ADSL or cable modems. The router has a built-in firewall to protect your PCs from outside hackers. Other features include remote configuration and management, VPN tunnelling, incoming port forwarding and much more.

Cat. YN-8090 $199.95

ADSL Line Splitter / Filter

The line outlets are filtered, removing any interference between the high speed connection and the telephone line. It features an RJ-12 socket for the telephone line, and two RJ-12 outlets.

Cat. YT-6094 $28.95

OVER 5,500 PRODUCTS IN STORE JAYCAR ELECTRONICS

Miniature Radio Controlled Cars with Turbo or Sound Effects

NEW

These tiny radio controlled cars are great. They all have a 5 minute run-time, and charge in just 45 seconds. 5 different models are available, modelled on the Nissan Skyline, Toyota Supra, Mazda RX-7, Mitsubishi EVO-7, and Mitsubishi Eclipse. All models are available with either racing effects, or a turbo feature, and the cars are just 66mm long.

Nissan Skyline with Turbo Feature Cat. GT-3030
Nissan Skyline with Sound Effects Cat. GT-3035

Toyota Supra with Turbo Feature Cat. GT-3031
Toyota Supra with Sound Effects Cat. GT-3036

Mitsubishi EVO-7 with Turbo Feature Cat. GT-3032
Mitsubishi EVO-7 with Sound Effects Cat. GT-3037

Mazda RX-7 with Turbo Feature Cat. GT-3033
Mazda RX-7 with Sound Effects Cat. GT-3038

Mitsubishi Eclipse with Turbo Feature Cat. GT-3034
Mitsubishi Eclipse with Sound Effects Cat. GT-3039

5 different models each available in 2 styles!

Price per Car $29.95

Too Hot To Print

Our Memory Card prices are too hot to put on paper. Drop into any store or see our website for the latest prices.

Great Savings on High Quality AV Leads

Premium AV cables that won't break the bank. See Cat Pg 216 for our extensive range.

3xRCA Plugs to 3xRCA Plugs – 3m

Was $34.95
Cat. WQ-7236 $29.95
Save $5

2xRCA Plugs to 2xRCA Plugs – 3m

Was $21.25
Cat. WQ-7228 $17.25
Save $4

S-Video 4 Pin Mini DIN Plug to Plug

Was $18.95
Cat. WQ-7216 $14.95
Save $4

Super Hi Fi Bi-FET Preamplifier Module

Features bass, treble, midrange, volume controls, and provisions for a loudness and tone defeat switch.

- Frequency response: 0Hz – 100Hz
- S/N Ratio: Phono -75dB, Tuner/Aux/Tape -90dB
- THD: 0.005% at rated output
- Size: 200(W) x 105(D)mm

Was $89.95 Save $10

Cat. AA-0315 $79.95

6 Way Power Outlet with Mains Filter and Telephone Line Protection

Features wide spaced sockets to suit multiple plugpacks.
Was $64.95
Save $20

Cat. MS-4022 $44.95

6 Way Power Board with Filter/Surge/Overload Protection for Power and Antenna

Protect your entire home theatre system!
Was $34.95
Save $15

Cat. MS-4058 $19.95

Mini Radio Controlled Battle Tanks

Engage your opponent in a one-on-one tank battle with these fantastic miniature radio controlled tanks. Featuring a rotating turret with an infrared 'cannon' that can fire on an opposing tank. Once a tank is 'shot', it will remain disabled for a few seconds until it is back in action.
Two tanks are required for battle games.

40Mhz Tank Cat. GT-3042

NEW

27Mhz Tank Cat. GT-3040

Price per Tank $44.95

Kingcell Alkaline Battery Bulk Packs

Buy in Bulk and Save!
Contains 24 Alkaline batteries. 2 sizes available. Virtually wholesale prices!

Handy for powered gifts

24 x AA Cat. SB-2330
Our AA Kingcell's sell for 99c ea in a pack of 4, these are only 54c ea! Save 45c ea!

24 x AAA Cat. SB-2331
Our AAA Kincell's sell for $1.13ea in a pack of 2, these are only 54c ea! Save 59c ea!

Both Sizes $12.95

100k Pixel Mini Digital Camera

- Measures just 60 x 43 x 17mm
- 352 x 288 max resolution
- USB Connection

Was $69.95
Save $20

Cat. QC-3190 $49.95

300k Pixel Mini Digital Camera

- Measures just 65 x 53 x 21mm
- Weighs just 41grams
- 640 x 480 max resolution
- USB Connection

Was $99.95
Save $20

Cat. QC-3192 $79.95

Great Savings on 12VDC to 230VAC Inverters!

All are modified square wave with reverse polarity and overload protection. They feature electrical isolation between the battery and secondary voltage for safety.

400W (1200W Surge)

Was $199.50
Cat. MI-5064 $159.50
Save $40

600W (1500W Surge)

Was $299
Cat. MI-5066 $249
Save $50

1000W (2400W Surge)

Was $529
Cat. MI-5070 $429
Save $100

Jaycar ELECTRONICS

Freecall For Orders 1800 022 888

www.jaycar.com.au

Mini Non-Contact Digital Thermometer with Laser Sighting

NEW

A great way to measure the surface temperature of an object without the need to make contact with it. It features a large LCD display, data hold, auto power off, and a range between -20°C to 270°C (-4°F to 518°F), with a 1° resolution. See Cat Pg 241 for details.

Cat. QH-7224 $99.95

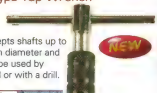
M3 and M4 Metric Taps and Driver Handle

Clean up a cross threaded nut or cut into a chassis or heatsink. High quality tool steel.

3mm Cat. TD-2440 $2.95

4mm Cat. TD-2442 $3.45

T-Type Tap Wrench



NEW

Accepts shafts up to 5mm diameter and can be used by hand or with a drill.

Cat. TD-2445 $12.95

BUY THIS DURATECH Temperature Controlled Soldering Station

- Lightweight soldering pencil.
- Rapid heat recovery with Japanese made ceramic heating element

Cat. TS-1580 $179.00

GET THESE FREE!

Deluxe Tip Cleaner Cat. TS-1510	Worth $12.95
1Kg Roll of 0.71mm Solder Cat. NS-3002	Worth $28.95
3mm Desolder Braid Cat. NS-3020	Worth $3.25

That's $45.15 Value Absolutely FREE!

DUE LATE SEPTEMBER

IF YOU SEE THIS SYMBOL PLEASE CALL US TO CHECK STOCK AVAILABILITY BEFORE DRIVING ACROSS TOWN.

High Quality Stainless Steel Hand Tools and Screwdrivers

A range of quality tools in #316 Marine Grade (3CR13) Stainless Steel. If you need to use tools in a hostile environment like saltwater, chemicals etc., or just want the best quality, then these tools are for you.

150mm (6") Diagonal Cutters
Cat. TH-2304 Only $12.95

170mm (7") Linesman's Pliers
Cat. TH-2308 Only $14.95

150mm (6") Long Nose Pliers
Cat. TH-2300 Only $12.95

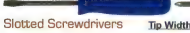
200mm (8") Adjustable Wrench
Cat. TH-2312 Only $17.95

250mm (10") Adjustable Wrench
Cat. TH-2316 Only $22.95

300mm (12") Adjustable Wrench
Cat. TH-2316 Only $29.95

250mm (10") Slip Joint Pliers
Cat. TH-2322 Only $22.95

300mm (12") Slip Joint Pliers
Cat. TH-2324 Only $29.95



Slotted Screwdrivers	Tip Width	Blade Length	
Cat. TD-2340	3.0	75mm	Only $3.95
Cat. TD-2342	4.0	100mm	Only $4.50
Cat. TD-2344	5.0	125mm	Only $4.95

Phillips Screwdrivers	Tip Size	Blade Length	
Cat. TD-2350	1	80mm	Only $3.95
Cat. TD-2352	2	100mm	Only $4.95

WHOOPS! A Ha' Penny of Tar.. 10" Metal Subwoofer Stuff-Up

NORMAL PRICE $199 SAVE 25%

The old saying of "spoiling the ship but for a ha' penny of tar" really applies here. Our first shipment of 10" Metal Coated Cone subs have arrived - but with a wee little problem. The iron pole piece which has a centre vent through it was not internally plated or painted. The result? Slight surface rust in the hole. The factory sent out a crew to paint them and, frankly, a monkey could have done a better job. We stopped them and decided to sell them off. Some are painted, some are not. Either way, the performance is not affected IN ANY WAY. The hole is still there to relieve back pressure on the driver part of the cone. You can take advantage of our distress by grabbing one, but BE QUICK! No rainchecks, and no backorders. Quantities strictly limited.

Cat. CS-2367 $149.00

18W Soldering Iron

This iron is perfect for precise soldering of delicate components. It offers rapid heat up, instant recovery, a stainless steel barrel and long life interchangeable tip. Fully SAA approved.

NEW

Cat. TS-1551 $34.95

60W SMD Soldering Iron

Using a conventional soldering iron for surface mount components can be slow and clumsy. With tips available from 2 – 20mm, its tweezer design makes light work of small resistors to large 'flat pack' IC's. It heats up in just minutes, and features rapid heat recovery. Supplied with a metal stand and 2 x 2mm tips.

Cat. TS-1700 $99.95 NEW

Spare Tips Available:

2mm Cat. TS-1701 $19.95 Pkt 2
5mm Cat. TS-1702 $24.95 Pkt 2
10mm Cat. TS-1703 $24.95 Pkt 2
20mm Cat. TS-1704 $24.95 Pkt 2

'Battery Fighter' Super Smart SLA Battery Chargers

BFA micro-chip technology applies the correct peak charge, then automatically maintains the battery at optimum float voltage which eliminates battery destroying sulfation. See our website for full details.

NEW

750mA Charger

Cat. MB-3600 $49.95

1.25A Charger

Cat. MB-3602 $79.95

Freecall For Orders 1800 022 888

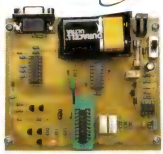
www.jaycar.com.au

Jaycar ELECTRONICS

Serial PIC Programmer Kit

NEW KIT

Ref: Silicon Chip September 2003.
This great little programmer can be battery powered! It features a portable, robust design, and has provisions for In Circuit Serial Programming (ICSP) for micros which support this programming feature. This avoids the need to unplug a PIC from it's circuit to make and test changes to the code. It simply connects to your PC's serial port. Kit supplied with PCB, and all electronic components. ZIF socket, serial cable and battery not supplied.



Cat. KC-5367 $39.95

2A DC-DC Converter Kit

Ref: Silicon Chip June 2003.
•Step up a 12V supply to between 13.8 and 24VDC.
•Efficient switchmode design.
•Kit includes PCB, electronic components, and silk screened front panel.

NEW KIT

Cat. KC-5358 $49.95

Clamp Meter Kit

NEW KIT

Ref: Silicon Chip September 2003.
AC/DC Current Clamp Meter Kit for DMM's A great low cost alternative to expensive current clamp meters. It uses a simple hall effect sensor, and iron ring core setup, and connects to your digital multimeter. It will measure AC and DC current, and has a calibration dial to allow for any magnetising of the core. Much cheaper than pre-built units. Kit supplied with PCB, clamp, case, silkscreened front panel and all electronic components.

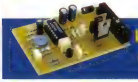
Cat. KC-5368 $34.95

Digital Instrument Display Kit for Cars

NEW KIT

Ref: Silicon Chip August 2003.
•Convert many analogue based sensors to digital readouts.
•Suits many automotive sensors.
•Kit includes PCB, electronic components, case, and silk screened front panel.

Cat. KC-5365 $59.95



LOOKING FOR AN OLD KIT?

If you are, we may have it in our 'Kit Back Catalogue.' The 'Kit Back Catalogue' range is listed on the Jaycar website (under Kits & Projects) and can only be purchased via the website "www.jaycar.com.au" or Techstore (i.e. not the Jaycar stores).

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Newcastle •Ph (02) 4965 3799
Parramatta •Ph (02) 9683 3377
Penrith •Ph (02) 4721 8337
Silverwater •Ph (02) 9741 8557
St. Leonards •Ph (02) 9439 4799
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Wellington •Ph (04) 801 9005
Christchurch •Ph (03) 379 1662
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Auto Power-Up Kit

NEW KIT

Ref: Silicon Chip July 2003.
•Switches on associated equipment when a 'master' device is powered up.
•Great for computers and home theatre systems.

•Kit includes PCB, electronic components, and silk screened front panel.

Cat. KC-5363 $79.95

'Smart' Slave Flash Trigger Kit for Cameras

NEW KIT

Ref: Silicon Chip July 2003
•Triggers separate flash systems for more professional looking photography.
•Works with standard and 'red eye reduction' flash systems.
•Kit includes PCB, electronic components, and silk screened front panel.

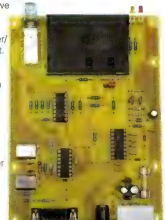
* Flash trigger lead not supplied.

Cat. KC-5364 $29.95

Full Function Smart Card Reader/Programmer Kit

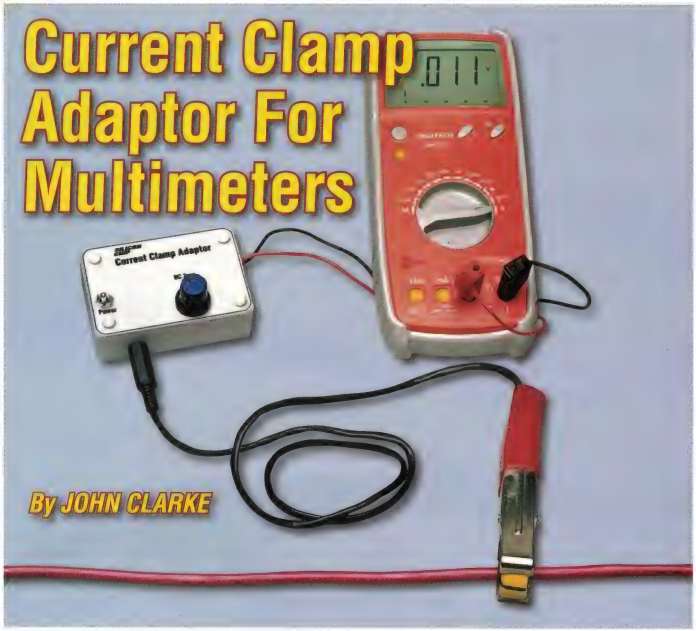
NEW KIT

Ref: Silicon Chip July 2003
In January 2003, we released the Phoenix Type Smart Card Reader/Reprogrammer Kit. It provide a great tool for accessing the EEPROM data of many popular Gold cards. Now we have a new design, which will program many blank Gold, Silver, and Emerald wafer cards (with relevant loader software) which conform to ISO-7816 pinout standards. PC connection is via serial port, and the PCB can be powered from a plugpack, 9V battery or your ATX power supply. Kit supplied with PCB, card socket, and all specified electronic components.
•Jaycar Electronics and Silicon Chip Magazine will not accept responsibility for the operation of this device, its related software, or its potential to be used for unlawful purposes



Cat. KC-5361 $49.95

Current Clamp Adaptor For Multimeters



By JOHN CLARKE

Looking for a current clamp meter that won't break the bank? Here's a simple clamp meter adaptor that you can build for about $35. It plugs into a standard DMM and can measure both AC and DC currents.

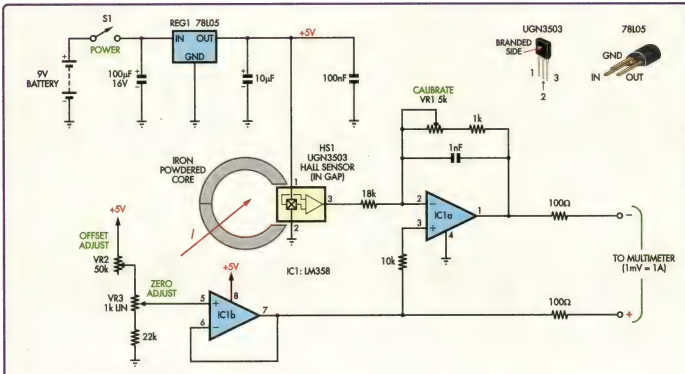
CLAMP METERS are very convenient when it comes to measuring current, since they do not require breaking the current path. Instead, they simply clip over the wire or lead that's carrying the current and the reading is then displayed on the meter.

This is not only much easier than "in-circuit" current measurements but is often a lot safer as well; eg, where high voltages and currents are involved. However, clamp meters are not particularly useful for making low-current measurements (ie, below 1A) due to their inaccuracy and lack of resolution.

Unlike this unit, many commercial current clamp meters can only measure AC. That's because they are basically current transformers, comprising turns of wire around a magnetic core. This magnetic core is clipped around the wire to be measured, which effectively behaves as a half-turn primary winding. The winding on the core itself acts as the secondary and connects to the multimeter's current terminals.

The measured current is a divided down value of the true current flowing in the wire. Usually, the division ratio is 1000:1 so that 1mA shown on the meter equates to 1A through the wire that's being measured.

Clamp meters capable of measuring DC as well as AC do not use a current transformer but a Hall effect sensor instead. This sensor is placed inside



CURRENT CLAMP ADAPTOR

Fig.1: the circuit uses Hall effect sensor HS1 which produces a voltage at its pin 3 output that depends on the magnetic field induced into an iron-powdered toroid core. This voltage is fed to op amp IC1a which then drives the negative terminal of the multimeter. IC1b drives the meter's positive terminal and provides null adjustment.

a gap in an iron-powdered toroid core. It measures the magnetic flux produced as a result of the current flowing through the wire and produces a proportional output voltage.

How it works

To make it as versatile as possible, the SILICON CHIP Clamp Meter Adaptor also uses a Hall effect sensor so that it can measure both DC and AC currents. The output of this sensor is then processed using a couple of low-cost op amps which then provide a signal for a standard DMM or analog multimeter.

When measuring DC current, the multimeter is set to its DC mV range and 1A through the wire in the core equates to a reading of 1mV on the meter. A potentiometer allows the output to be nulled (ie, adjusted to 0mV) when there is no current flow.

Similarly, for AC current measurements using the clamp meter, the multimeter is simply set to its AC mV range. In this case, the DC offset potentiometer is not needed, since the multimeter automatically ignores any DC levels.

The high-frequency response of the adaptor for AC measurements is 3dB down at 20kHz (ie, 0.7071 of the real value). However, the actual measurement displayed will also depend on the high-frequency response of the multimeter itself. Some multimeters give useful readings up to 20kHz, while others begin to roll off the signal above 1kHz (ie, frequencies above this will not be accurately measured).

If necessary, the output from the Clamp Meter Adaptor can be monitored using an oscilloscope if AC measurements have to be made at high frequencies. However, AC current measurements at 50Hz (ie, the mains frequency) will be accurate using virtually any multimeter.

Note that most multimeters are calibrated to display the RMS values of AC current measurements, although they are only accurate for sinusoidal waveforms. This unit will not affect meter calibration, since it does not change the shape of the waveform for signals below 20kHz and only converts the current waveform to a voltage waveform. However, for non-sinusoidal waveforms, the multimeter will display an erroneous result unless it is a true RMS type.

Specifications

Output: 1A = 1mV for AC and DC ranges

Resolution: multimeter dependent (100mA with 0.1mV resolution on multimeter)

Maximum DC current: 150A recommended (up to 900A if core is demagnetised afterwards)

Maximum AC current: 630A recommended

Linearity: typically better than 4% over range at 25°C

AC frequency response: -3dB at 20kHz (meter reading depends on multimeter AC response)

Current consumption: 15mA

Demagnetising the core

One problem with clamp meters is that the core can remain magnetised

after making high DC current measurements; ie, even when the current flow has been reduced to zero. In fact, this effect becomes apparent when measuring DC currents above about 150A. It is easily detected because the output from the sensor remains at several millivolts after the current ceases flowing.

Fortunately, there's an easy solution to this. If the core does become magnetised, it can be demagnetised again by momentarily reversing the current flow in the core.

In practice, this is done by unclipping the core from the wire, replacing it over the wire upside down and applying the current again for a brief period of time.

Modified battery clamp

To keep costs down, the SILICON CHIP Clamp Meter Adaptor uses a modified car battery clip as the current clamp. This is fitted with an iron-powdered toroid core which is cut in half so that the clip can be opened and slipped over the current-carrying wire. The Hall effect sensor sits in a gap in the toroid, near the front of the clip – see Fig.2.

The output from this sensor is fed to a processing circuit which is built on a small PC board and housed in a plastic case, along with the battery. This circuit in turn connects to the meter via two leads.

By the way, commercial clamp meters using Hall effect sensors usually place the sensor at the hinge end of the core. This can be done when the clamp material is non-magnetic. However, when the clamp is magnetic, as in this design, the magnetic flux is conducted through it instead and bypasses the air gap where the sensor sits – see Fig.2 (top drawing).

This problem is solved by simply placing the sensor in an air gap at the front of the clamp, so that it cannot be bypassed.

Circuit details

Refer now to Fig.1 for the circuit details. It's relatively simple and comprises a dual op amp (IC1a & IC1b), a 3-terminal regulator (REG1), the Hall effect sensor (HS1) and a few resistors and capacitors.

Power for the circuit is derived from a 9V battery and is fed to REG1 which provides a regulated +5V rail. This then powers the Hall effect sensor and op amps IC1a & IC1b. Note that a regulated supply is necessary, since the Hall sensor output will vary with supply rail variations.

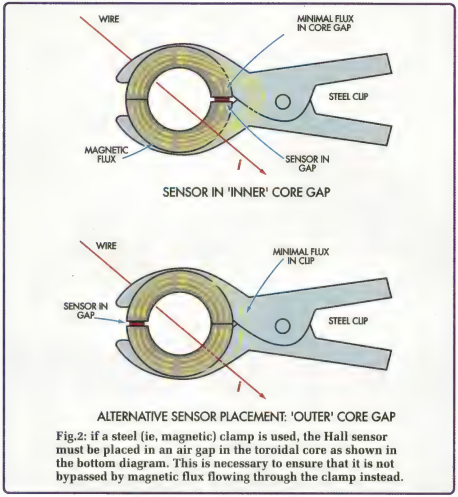


Fig.2: if a steel (ie, magnetic) clamp is used, the Hall sensor must be placed in an air gap in the toroidal core as shown in the bottom diagram. This is necessary to ensure that it is not bypassed by magnetic flux flowing through the clamp instead.

In operation, the Hall effect sensor produces a voltage at its pin 3 output that depends on the magnetic field in the core. If the marked face of the sensor faces a south magnetic field, its output voltage will rise. Conversely, if it faces a north field, the output voltage will fall.

The sensor's output with no magnetic field applied to it will sit between 2.25V and 2.75V, depending on the sensor. This voltage remains stable, providing the supply voltage remains stable.

The output of the Hall effect sensor is fed to op amp IC1a. This stage is wired as an inverting amplifier and it attenuates the signal by an amount that depends on the setting of trimpot VR1 (calibrate). Note that the gain of IC1a is set by the resistance between pins 1 & 2 divided by the 18kΩ input resistor.

This means that if VR1 is set to halfway, IC1a has a gain of (2.5kΩ + 1kΩ)/18kΩ = 0.19.

In practice, VR1 is adjusted so that it produces an output of 1mV per amp flowing through the current-carrying wire.

Op amp IC1b and its associated circuitry compensate for the initial DC voltage at the output of the Hall effect sensor (ie, with no magnetic field applied). As shown, IC1b is connected as a unity gain buffer with its output connected to its pin 6 inverting input. The non-inverting input at pin 5 connects to a resistive divider network consisting of VR2, VR3 and a 22kΩ resistor.

The output from IC1b (pin 7) goes to the positive meter terminal and is also used to bias pin 3 of IC1a via a 10kΩ resistor. This bias voltage is nominally about 2.5V (ie, 0.5Vcc) and allows the output of IC1a to swing up or down about this voltage, depending on the sensor input. It also effectively allows the quiescent voltage from the Hall sensor to be nulled so that we get a 0V reading on the meter

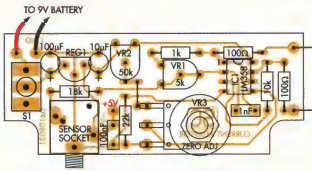


Fig.3: install the parts on the PC board as shown here. The Zero Adjust pot (VR3) is installed by soldering its terminals to three PC stakes.

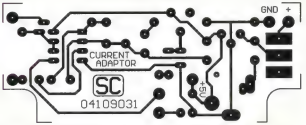


Fig.4: the full-size etching pattern for the PC board.

when no current is being measured.

VR2 is initially adjusted with VR3 set to mid-range, so that the multimeter reads 0V with no magnetic field applied to the Hall sensor. VR3 is then adjusted during subsequent use of the clamp meter – it can vary IC1b's output by about 25mV to null out any small voltage readings.

In effect, trimpot VR2 acts as a coarse offset adjustment, while VR3 allows fine adjustment to precisely zero the reading.

Looked at another way, VR2 & VR3 are simply adjusted so that the voltage on pin 7 of IC1b is the same as the voltage on pin 1 of IC1a when there is no magnetic field applied to the Hall effect sensor – ie, the voltage between pins 1 & 7 is 0V.

The outputs from both op amps are fed to the multimeter via 100Ω resistors. These provide short-circuit protection for the op amp outputs and also decouple the outputs from the cable capacitance.

Construction

Building the circuit is easy since all the parts are mounted on a small PC board coded 04109031 and measuring 75 x 30mm. Begin construction by checking the PC board for any shorts between tracks and for any breaks in the copper pattern. Also check that the hole sizes are all correct for the various components, particularly those for the PC-mount stereo socket and the on/off switch (S1).

Note that two of the corners on the PC board need to removed to allow the board to clear the corner pillars inside the case. If your board is supplied with these corners intact, they can be cut away using a small hacksaw and carefully finished off using a rat-tail file.

Fig.3 shows the assembly details. Install the resistors and wire link first, using Table 1 to guide you on the resistor colour codes. It's also a good idea to check the resistor values with a DMM, just to make sure.

IC1 can go in next, taking care to ensure that it is oriented correctly. That done, install the trimpots and the capacitors, noting that the electrolytics must be oriented with the polarity shown. The trimpots are usually labelled with a code value, with 502 equivalent to 5kΩ (VR1) and 503 equivalent to 50kΩ (VR2).

Next, install PC stakes at the two power supply inputs, the +5V terminal, the three VR3 terminal positions and the two multimeter outputs. These can be followed with the switch and the PC-mount stereo socket.

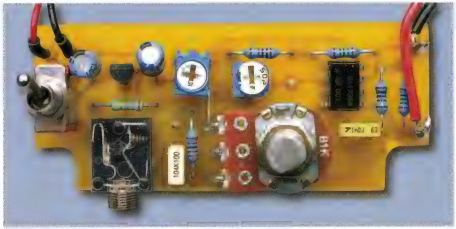
Finally, complete the board assembly by installing potentiometer VR3 – it is mounted with its terminals soldered to the top of its PC stakes. Position it so that the top of its mounting thread is at the same height as the top of the switch thread.

Drilling the case

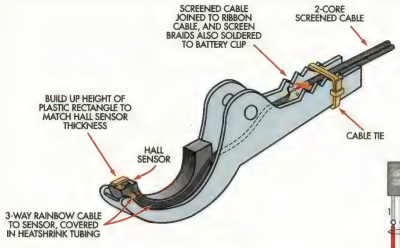
The front panel artwork can now be used as a template to mark out and drill the lid of the small plastic utility case that's used to house the board. You will need to drill two holes – one for the switch and the other for the potentiometer.

In addition, you will have to drill a 4mm hole in one end of the case for the multimeter leads, plus a 7mm hole in one side to accept the stereo socket. The latter should be positioned 14mm down from the top of the case and 21mm in from the outside edge.

Note that it's always best to drill small pilot holes first and then carefully enlarge them to size using a tapered reamer.



Check your completed PC board assembly carefully to ensure that all polarised components have been correctly installed. These parts include IC1, REG1 and the two electrolytic capacitors.



SENSOR PLACEMENT

Fig.5 (above): this exploded diagram shows how the toroid core and Hall sensor are fitted to the clamp. Each core half is secured in position using builders' adhesive, as are the Hall sensor and the adjacent plastic rectangle. Note the earth connection to the metalwork of the clamp.

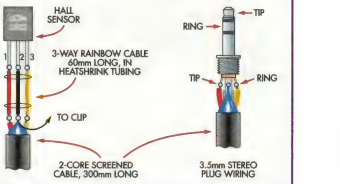


Fig.6 (below): a 60mm-length of 3-way rainbow cable is used to make the connections to the Hall sensor. This cable is then joined to a 300mm length of 2-core shielded cable which is then terminated in 3.5mm stereo plug.

Next, the integral side clips inside the box need to be removed using a chisel. Be sure to protect your eyes when doing this, as the plastic tends to splinter and fly out. You can then attach the front panel label and cut the holes out with a sharp knife.

The next step is to solder the battery clip leads to the supply terminals (red to positive, black to negative). That done, connect the multimeter leads to the output terminals, then feed these wires through the hole in the box and attach banana plugs to each free end.

Don't fit the board to the case lid at this stage. That step comes later, after calibration has been completed.

Clamp assembly

The clamp assembly comprises a car battery clip, the toroidal core and the Hall effect sensor. Figs.5 & 6 show the assembly details for this unit.

The first step is to cut the core in half using a fine-toothed hacksaw blade. That done, the Hall sensor should be wired using a 60mm length of 3-way rainbow cable which should be sheathed in heatshrink tubing (see Fig.5). The other end of this cable is then connected to a 300mm length of 2-core shielded cable which in turn is terminated with a 3.5mm stereo plug.

As shown in Fig.6, the cable shields are joined together and connected to the earth lead of the rainbow cable. They are also connected to the metalwork of the clip using a short length of hookup wire. Small pieces of insulating tape should be used to prevent

This view of the completed current clamp clearly shows the general arrangement. If the toroid core becomes magnetised during use, it can be demagnetised by momentarily reversing the current flow in the core.

Table 2: Capacitor Codes

Value	µF Code	EIA Code	IEC Code
100nF	0.1µF	104	100n
1nF	0.001µF	102	1n0

Table 1: Resistor Colour Codes

❑	No.	Value	4-Band Code (1%)	5-Band Code (1%)
❑	1	22kΩ	red red orange brown	red red black red brown
❑	1	18kΩ	brown grey orange brown	brown grey black red brown
❑	1	10kΩ	brown black orange brown	brown black black red brown
❑	1	1kΩ	brown black red brown	brown black black brown brown
❑	2	100Ω	brown black brown brown	brown black black black brown

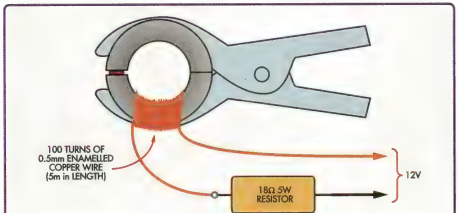


Fig.7: this simple setup can be used to calibrate the Clamp Meter Adapter. Null the reading first using potentiometer VR3, then switch on the 12V supply and adjust trimpot VR1 for a reading of 66.7mV.

shorts between the wires where the cables join, after which the join should be covered using heatshrink tubing.

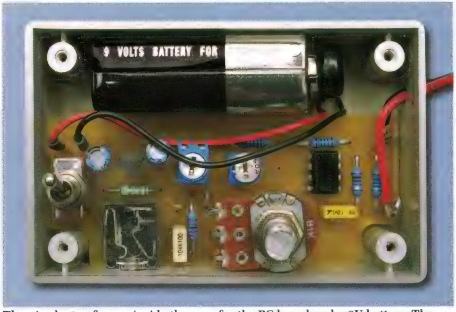
The next step is to glue the Hall sensor to one of the core pieces using some builders' adhesive (it can go in either way up). That done, glue a small piece of plastic to the remaining part of the core gap to protect the Hall sensor from damage when the clamp closes. Naturally, this piece of plastic needs to be slightly thicker than the Hall sensor to provide this protection.

The two core pieces can now be glued in position on the jaws of the battery clip, again using builders' adhesive. Make sure that the two halves are correctly aligned before the glue sets.

Once the core pieces are secure, the wiring for the Hall sensor can be glued in position and secured at the end of the clip with a cable tie. In addition, the metal tabs on the clip should be bent over to hold the wire in place. This must also be done on the other handle, so that the jaws of the clamp can be opened as wide as possible.

The 3.5mm stereo plug is wired as shown, with the tip and ring terminals connecting to the red and black wires respectively. If your twin shielded wire has different colours, take care to ensure that pin 1 on the Hall sensor goes to the tip connection. Pin 3 must go to the ring terminal and pin 2 is the ground and shield.

As it stands, the clamp can be slipped over leads up to 7mm in diameter. A larger clamp with jaws that open wider than the specified unit will be necessary if you intend measuring currents flowing in leads that are thicker than 7mm.



There's plenty of room inside the case for the PC board and a 9V battery. The board is held in position by slipping the case lid over the switch and pot shafts and doing up the nuts.

Testing

The Clamp Meter Adapter is now ready for testing. First, connect the battery and check that there is +5V at the test point on the PC board (ie, 5V between this test point and ground). There should also be +5V on pin 8 of IC1.

If these measurements check OK, plug the clamp assembly into the socket on the PC board and check the voltages again. If they are no longer correct, check component placement and the wiring to the Hall sensor.

Next, connect the output leads from the unit to the voltage inputs on your multimeter and set the range to mV DC. That done, set VR3 to its mid-position and adjust trimpot VR2 for a reading of 0mV.

Calibration

The Current Clamp Adaptor is calibrated using a 12V power supply, a 5m length of 0.5mm enamelled copper wire and an 18Ω 5W resistor.

First, wind 100 turns of the ECW around the core and connect it to the 12V supply via the 18Ω resistor as shown in Fig.7. The current through the wire will be 12/18 = 0.667A and, as far as the clamp meter is concerned, this is effectively multiplied by 100 due to the number of turns on the core.

All you have to do now is adjust VR1 for a reading of 66.7mV. And that's it – the calibration is complete!

Note that if the power supply is not exactly 12V, you can compensate for this by calibrating to a different reading. Just measure the supply voltage, divide the value by 18 (to get the current) and multiply by 100 to obtain the calibration number.

For example, if you are using a 13.8V supply, you will have to set VR1 for a reading of 76.7mV on the meter (ie, 13.8/18 x 100) = 76.7).

Once the calibration has been completed, the PC board can be attached to the case lid. It's held in place sim-

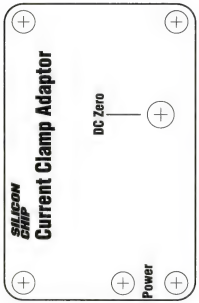


Fig.8: this full-size artwork for the front panel.

ply by slipping the lid over the switch and pot shafts and doing up the nuts.

Using the clamp meter

Note that before making a measurement, the DC Zero potentiometer must first be adjusted so the multimeter reads 0mV when there is no current flow. Note also that the core may need to be demagnetised after measuring high DC currents, as described previously. This will be necessary when the DC Zero control no longer has sufficient range to null the reading.

When measuring relatively low currents (eg, between 100mA and 10A), increasing the number of turns of the current-carrying wire through the core will improve the resolution. However, this will only be possible if the wire diameter allow the extra turns to be fed through the core.

Note that the readout on the multimeter must be divided by the number of turns through the core to obtain the correct current reading. Note also that the accuracy of the unit will vary according to the temperature of the Hall sensor, particularly when making high current measurements.

By the way, it's a good idea to mark the top of the clamp with an arrow to indicate the direction of positive current flow once you have the unit working correctly. This can easily be determined by trial and error.

Finally, do not forget to switch the unit off when it is not in use. There's no power indicator LED to warn you that the unit is on (to conserve battery life), so take care here! SC

Parts List

1 PC board, code 04109031, 75 x 30mm
1 front panel label, 80 x 52mm
1 plastic box, 82 x 54 x 30mm
1 iron powdered toroidal core, 28 x 14 x 11mm (Jaycar LO-1244 or equivalent)
1 50A car battery clip (DSE P-6424 or equivalent)
1 3.5mm stereo PC board mount socket (Jaycar PS-0133 or equivalent)
1 3.5mm stereo jack plug
1 SPDT toggle switch (S1)
1 5kΩ (code 502) horizontal trimpot (VR1)
1 50kΩ (code 503) horizontal trimpot (VR2)
1 1kΩ 16mm linear potentiometer (VR3)
1 red banana line plug
1 black banana line plug
1 9V battery clip
1 9V battery
1 potentiometer knob
1 4 x 4 x 2mm piece of soft plastic
1 300mm length of twin core shielded cable
1 60mm length of 3-way rainbow cable
1 200mm length of red heavy duty hookup wire
1 200mm length of black heavy duty hookup wire
1 50mm length of green heavy duty hookup wire
1 50mm length of 4.8mm diameter heatshrink tubing
1 100mm cable tie
8 PC stakes

Semiconductors
1 LM358 dual op amp (IC1)
1 UGN3503 Hall effect sensor
1 78L05 5V regulator (REG1)

Capacitors
1 100µF 16V PC electrolytic
1 10µF 16V PC electrolytic
1 100nF MKT polyester
1 1nF MKT polyester

Resistors (1% 0.25W)
1 22kΩ
1 18kΩ
1 10kΩ
1 1kΩ
2 100Ω

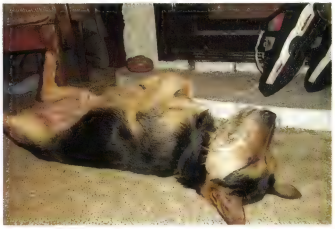
Calibration parts
1 5m length of 0.5mm enamelled copper wire
1 18Ω 5W resistor

There's no power LED on the front panel to warn you when the power is on (to save battery life), so be sure to switch the unit off when it is not in use. Also, be sure to null the reading on the multimeter (ie, when there is no current flow through the core) before taking a measurement.

To sleep, perchance to dream (or nap) . . .

(and PICAXE datalogging too!)

Quite aside from all their other benefits, the inbuilt micro-power standby features of Picaxes – sending them to sleep – can *greatly* enhance battery life.
A new use for apparently "dead" batteries, perhaps?



by Stan Swan

Given the prevalence of portable devices (refer June "SILICON CHIP" editorial!) this alone should win favour for projects such as torches and data loggers used away from a mains supply.

There are four distinct commands, and several code techniques, to organise this.

PAUSE – introduces a program delay in milliseconds.

Example: pause 100 = 100ms

Maximum delay is 65535ms (a little over one minute) with about 1ms overhead. Of course, we've used pause a lot in earlier articles for LED flashing etc. No power saving.

WAIT – equivalent to pause, but with larger units

Example: wait 10 = 10 seconds

Up to 65.5 seconds wait possible, but again no power saving activated

NAP – Enters a low power short period mode.

Example: nap 3 yields a 144ms delay.

The eight nap period values (0-7), yield a duration given by the formula:

Delay (in ms) = 2^time value x 18.

Hence Nap 0= 18ms, while nap 1= 36ms, nap 2= 72 ms , nap 3 = 144ms etc. Nap 7 = 2304ms (2.3 seconds).

SLEEP – Also enters a low power long period mode (2.3 seconds units).

Example: Sleep 10 = ~23 seconds.

Although of high accuracy, resolution is lower and overall times can amount to ±1% deviation (perhaps up to 30 seconds drift in an hour.) The maximum sleep value, of 65535 (being 256 x 256) extends to days, but could be temperature dependent. Hence don't set your alarm clock by this...

Other delays

Unusual delays, not catered for above, can perhaps be organised by "do nothing" nested loops that may run to minutes. Hence a 100 x 100 = 10,000 count, could involve code looping inside loops and be set up perhaps for b0=1 to 100: for b1= 1 to 100: next b1: next b0

A further alternative may be to exploit the serin command, which patiently awaits the arrival of serial data bytes – perhaps from a linked PC timer. Rev. Ed's AXE033 LCD display in fact includes a DS1307 real time clock chip offering this feature, allowing precise intervals to be set.

OK – you know all about **pause**, so let's first put **nap** to work in yet another LED flashing circuit.

Another one? As we've mentioned before in this series, pulsed or flashing LEDs attract attention, help identify the source and also save battery power. And the PICAXE is perfect for doing it! The classic 1970s LM3909 IC enjoyed decades of use in just this field but that was – well – the 20th century.

If the flash rate is fast enough (>20Hz or so) human persistence of vision comes into play as well and the puls-

ing light "looks" to be just a steady source.

Hence it's "win win" – appearing to be on but saving significant power – and with today's ultrabright white LEDS, battery life can be hugely extended – an important issue in emergencies or even lesser developed countries rural lighting.

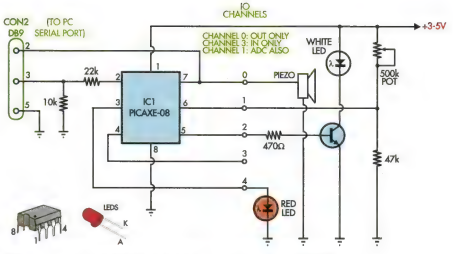
Take note however – flash rates around 7-10Hz are particularly irritating (they've even been used for riot control) and in extreme cases may bring on epileptic fits.

Power down

Rather than just have a short pause between such LED flashes, it's maybe better to use the brief power down features of nap. When devices are being worked hard, such as the "over driven" white LED here, this brief cool-down spell may help to ease the thermal stress on the LED (normally limited to ~30mA but capable of withstanding 100mA *pulses*).

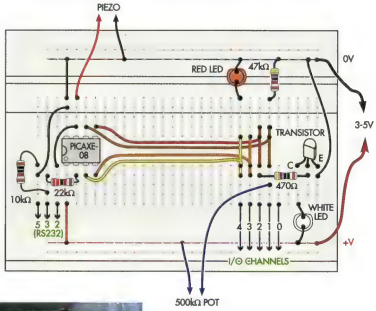
Recall that **readadc** command from the "Door Minder" article (SILICON CHIP March 2003)? This has been further extended here so that the presented resistance from a 500kΩ pot selects the flash sequences.

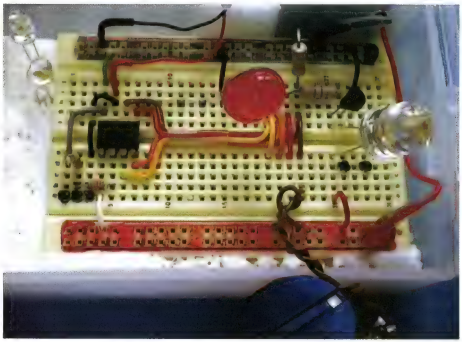
Such resistances could have been set with a multi-position switch and assorted resistors, or even maybe a stepped push switch but the pot simplifies things nicely. Note the generous program comments!



SC 0303

PICAXE NAPPING LEDS CIRCUIT





(Above): the circuit diagram and protoboard layout for the first part of this month's PICAXE series – using the various "slumber" commands to save battery power in the LEDs. This is used in conjunction with the "LEDNAP" program overleaf.

As usual, the photo is just slightly different from the protoboard layout above (we've moved some components for clarity in the drawing). The pulsed white 5000mCd LED (from Jaycar) used here stands out like a lighthouse at night and is easily visible several kilometres away.

In contrast to catnaps, **sleep** is intended for some serious PICAXE downtime resting! During such a sleep, power demands were found to drop to the 100µA range, (although brief wake up surges have been reported), hence almost offer a new use for otherwise "dead" batteries.

The 2.3 second unit (being the upper value of nap7) implies a super nap is invoked. The maximum sleep value (65535), extends to some days and sequential sleeps could stretch to (maybe) months.

For portable work, battery life may ultimately limit the program duration but a 1000mAh NiMH should last 10,000 hours (over a year) which may compare with its shelf life!

Or a small photo-voltaic panel could keep a rechargeable pack trickle-charged. These aspects are naturally an issue for portable applications such as our data logger.

LEDNAP.BAS

(Also downloadable from: www.picaxe.orcon.net.nz/lednap.bas)

```
'LEDNAP.BAS program for September "Silicon Chip" Picaxe-08 article. Ver 1.0 12/7/03
'Potentiometer acts as multi position switch! Stan. SWAN = s.t.swan@massey.ac.nz
'Values as set here allow 7 different flash types to be dialled up via the 500k pot
'Much tweaking still possible-better reading b0 ranges,alter pot(Log?),R value etc
'White LED (10mm ?) via BC547 with 470 Ohms from its base to Picaxe pin 2 via "NAP".
'Actual nap value depends on application - steady light,standby, rescue beacon etc
'Even nap 0 has distinctive ~20 Hz flicker = ideal bike front for attention getting?
'NB ~10Hz flicker is most irritating to many observers - may cause epileptic fit?!
'On 3AA 4.5V supply & 470 base R,typical DSE Lux meter values (pulsed of course) ~
'nap 0=35mA 340 Lux, nap 1=22mA 216 Lux, nap 2= 13mA 120 Lux, nap 3= 8mA 70 Lux
'nap duration = 2^period x ~18ms , with period values 0-7 ( rolled over if beyond )
'nap 0 ~18ms, nap 1 ~36ms, nap 2 ~72ms, nap 3 ~144ms, nap 7 ~ 2secs
'Inbuilt loop o'head of course distorts M/S ratio. Red LED direct driven from pin 4
'Program download from = www.picaxe.orcon.net.nz/lednap.bas Comments (') optional
'-----
ledflash:                   'main adc read to set nap time or dim with pwm etc
 readadc 1,b0               'ADC read pin1 -via 500k pot(Log?) & 47k V.divider
b1= b0/22                   'divide returned "nap" value so fits in 0-7 range
if b1=0 then redflash       '"08" readadc values are in 16 blocks 0-160,11 wide
if b1=1 then redpwm         'Could use as is,but division OK for just 7 values
if b1=7 then beacon         '1/2 Hz beacon mode nap 7 forced via b2 variable
'-----
whiteflash:                 'routine for normal adjustable white flash rates
  b2=b1-2                   'tweak returned b1 rates,since too short as divided
    high 2:pause 10:low 2   'LED pulse ~ somewhat overdriving via transistor
  nap b2                    'brief snooze to allow LED/BC547 cool down !
goto ledflash               'return to main pot. reading procedure
'-----
redflash:                   'red led at pin 4 flash - rear bike light style
  high 4:pause 10:low 4:nap 7   'pulsed ~ every 2 seconds - adjust to suit needs
goto ledflash               'return to main pot. reading procedure
'-----
redpwm:                     'red led attractive pulsing effect
  for b3=0 to 255 step 2    'loop so red LED has pleasing brightness increase
    pwm 4,b3,1 :next b3     'PWM pin 4 LED one cycle at increasing pulse width
      for b3=255 to 0 step -2   'loop to fade led out
    pwm 4,b3,1              'PWM pin 2 led one cycle at decreasing pulse width
  next b3:pause 300         'led displays a pleasing "heartbeat" effect !
goto ledflash               'return to main pot. reading procedure
'-----
beacon:                     'battery life prolonging (weeks ?) beacon flash
      high 2:pause 10:low 2 'brief led pulse - via transistor.Approx 1mA draw
nap 7                       '~ 2 sec delay between pulses
goto ledflash               'return to main pot. reading procedure
```

What – a Picaxe data logger?

Yes – although just a baby, the "08" has a 64 bytes non volatile memory (EEPROM). Any data (of values 0 –255) can be stashed away here (in ascending locations 0,1,2. – 64), although programs (stored downward 128,127 etc) share the same RAM and can be overwritten if care is not taken!

Key commands used are **write** and **read**, which store or retrieve during a program run, much as you'd keep a pencilled scratchpad of (say) items during a stocktake.

The EEPROM (Electrically Erasable Programmable Read Only Memory) command is intended to "pre store" values, either ASCII or data, so they are available once the program gets to work. No battery backup is needed to hold this data, since the memory is Flash RAM based. Here's a simple code snippet example –

```
EEPROM (13,7,19,69) ' pre stores bytes
   13,7,19,69 at locations 0,1,2,3 if free
write b1 ' stores b1 value at memory location
   staring from next available (4 here)
read b0 ' read b0 retrieves this value for
   program use
```

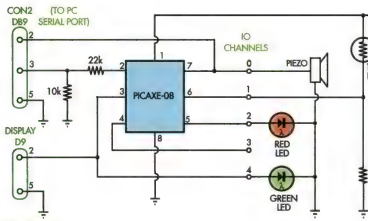
Due to the "Von Neumann architecture" nature of the 08, its memory can't be easily extended, sadly ruling out use of cheap I²C RAM chips. Even though 64 bytes may seem too trivial to exploit, it's proven ideal for recording voltage divider network values via the "08" **readadc** command. Don't get too excited - only low resolution is possible, and an upper limit value of 160 applies, but some 16 unique values may be detected and stored.

Data loggers of course allow valuable monitoring of such "real world" values as temperature, earthquakes, wind speeds, voltages, traffic, pH etc - maybe too tedious or hazardous for human recorders.

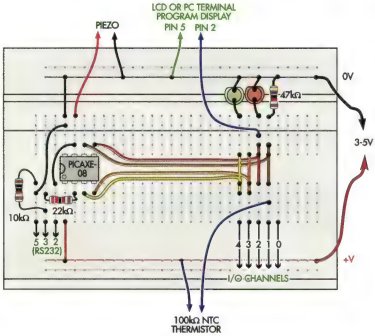
Educators may quibble but humans are arguably better employed than just watching dials and writing down numbers and additionally we're often devious, lazy or deceitful – perhaps "snoozing" when a key value arrives! Direct computer analysis is eased with machine gathering too.

OK, you're convinced – but aren't such data loggers costly? Read on!

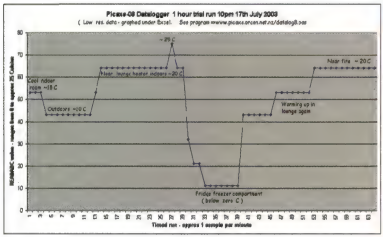
The deceptively simple Picaxe-08



SC PICAXE DATA LOGGER



Part two for this month: data logging with the PICAXE-08. Here's the circuit diagram and protoboard layout.



An Excel spreadsheet plot of the data obtained from our PICAXE logger, in this case being used as a temperature logger. It shows the readings over one hour in various locations – just to give you some idea of what the PICAXE logger can be put to!

circuit (at right) and program (overleaf) uses a 100kΩ/25°C NTC thermistor as a temperature sensor in simple automated application, with a sleep period initially set to take readings every minute for an hour. Since only 64 program bytes were available (the other 64 being used for data of course) refinements were limited, and the readout technique a compromise.

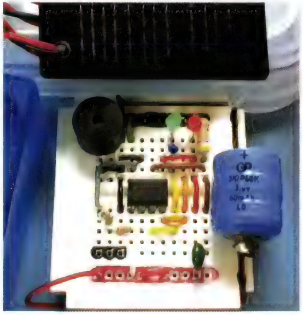
But as the Excel graph shows, very distinctive thermal environments were easily logged, and applications abound even as it stands!

Mmm – how about checking the heating/cooling rate of a spa pool as a guide to its insulation performance – waterproof the sensor of course. Monitoring an air conditioner - the period to bring rooms to a desired temperature perhaps? Replace the NTC with an LDR and note illumination changes – room lighting /security etc. Check actual voltages of discharging battery packs for relative performance?

Incidentally, we'll be extending this design later with a Picaxe 18A (and 18X – due late 2003), offering higher resolution, multi-channel and more memory, so stay tuned.

To overcome the "08" lo-res limitation, an elegant ramping solution has just been suggested. This sets up the PWM command to feed incremental pulsed PWM bursts into a capacitor

OK, this one is really different because it is built on a mini protoboard, whereas the diagram above is based on the standard protoboard we have used throughout this series. Either is perfectly suitable (especially if you already have one or other!). That's a 4V 20mA PV panel at top – rescued from a budget garden lamp.



DATALOG8.BAS

(Also downloadable from: www.picaxe.orcon.net.nz/datalog8.bas)

```
'DATALOG program for September "Silicon Chip" Picaxe-08 article.  Ver 1.02   24/7/03
'Use with attached 100k thermistor etc pin 1.  Via Stan.SWAN => s.t.swan@massey.ac.nz
'When "08" powered up,any prior stored EEPROM values sent as pin 4 serial port data
'Display this gathered data via any terminal program -LCD,BananaCom,F8,StampPlot etc.
'If saved via a terminal program,the ".csv" data can of course be Excel graphed too
'NB-Gives you 30secs to turn unit OFF before fresh storage begins & thus wiping old!
'**** CARE - BE PROMPT ! REPROGRAMMING/RELOADING  "08" TOTALLY WIPES DATA TOO ****.
'As set up logs temp in 0-30 C range every min for 1 hr.WAIT more accurate than SLEEP?
'Tweaking V divider network Rs may allow narrower temp range.Alter 47k to 100k maybe
'Picaxe 18A should run this OK too, but give high res readings & store 256 values.Yah!
'_____________________________________________________________________________
'Picaxe data storage value range 0-255,although only to 160 via "08" readadc of course.
'EEPROM builds up from location 0,but program builds down from 128. Just 61 bytes used
'Basic EEPROM syntax is ex. EEPROM (13,7,19,69 ) where bytes 13,7,19,69 EEPROM stored
'at locations 0,1,2,3. Code use READ & WRITE to access this data at these spots maybe
'To retain program simplicity & maximise number of readings, data can not be viewed as
'gathered.In practise this should not be an issue, since data logger likely to be used
'stand alone/ outdoors etc, then retrieved to display values back at an indoor PC etc.
'N.B.SLEEP not 1:1,as unit=2.3 secs.Elapsed times ~x2 expected.By trial SLEEP 25=1 min
'Stored values are non volatile - thus no need battery backup connection once gathered
'PIC makers (Microchip) say data retained in EEPROM >40 years unless overwritten.Bravo
'Typical (baby Wish board!) hardware setup pix=>  www.picaxe.orcon.net.nz/datalog8.jpg
'With sample Excel graph resulting (1 hour run)=> www.picaxe.orcon.net.nz/datalog8.gif
' ****** Download this program via => www.picaxe.orcon.net.nz/datalog8.bas <=  ******
'_____________________________________________________________________________
'ASCII art schematic                    Typical temp. readings/readadc values
'                 ------  -ve rail                  0 Celsius      11
' Piezo   _____   Pin I   I                         4              21
' Pin 0   ___ I  2 LED  47k                         8              32
'   ______   I I_______I   I                       12              43
'   IPicaxeI  I_______________I                    16              53
'   I 08 I   Pin 1 ADC   I                         20              64
'   ______            100k                         24              75
'          I_______Pin 4      NTC                  28              86 etc
' III              serout      I     3-5 V
'Usual 3 wire        + + + + + +  +ve supply     NOTE - Temp values approximate
'prog.input                                & may need better calibration
'_____________________________________________________________________________
                                        'READ/PLAYBACK ROUTINE
 serout 4,n2400,(12,"Datalog ")         'ASCII values 10=CR, 12=FF(=cls),13=LF, 44=comma
for b0= 0 to 63                         'stored data values readout to terminal or LCD
read b0,b1                              'polls & reads out stored eeprom values ( .csv)
serout 4,n2400,(44,#b1)                 'comma,then value @ pin 4. LED to show data too?
next b0                                 'read next stored EEPROM value out
wait 30                                 '30 secs "reading" delay -modify if too short etc
'_____________________________________________________________________________
                                        'WRITE/DATA LOGGING ROUTINE
for b0= 0 to 63                         'begin 64 data readings at time set by SLEEP
sound 0,(75,10)                         'Beep to alert data logging commencing
pulsout 2,500                           'brief flash from pin 2 LED indicates datalogging
readadc 1,b2                            'b2 has 16 blocks 11 wide (range 0-160),so 21 etc
write b0,b2                             'sequentially write values to EEPROM locations
sleep 25                                '25x2.3secs ~1 min delay (+/- 1% )-alter to suit
next b0                                 'Ex. Sleep 782 yields 64 x 1/2 hr =32 hrs data!
                                        'Data gathering stops when 64 readings taken
'_____________________________________________________________________________
```

and NTC/LDR until the preset digital threshold is reached, at which point values are recorded and "serout" passed to be read (or graphed) on an attached screen.

This naturally feeds *live* values rather than logged ones, but implies up to three channels of hi-res data (values 0 – 255) could be simultaneously gathered and PC stored. Check www.picaxe.orcon.net.nz/datagath.bas for the full program.

The circuit

Son of a Picnik box!

Until now, all our circuits have been based on a full-sized solderless protoboard. And that's what the diagram overleaf shows. (We figure that by now anyone experimenting with PICAXEs would have one of these protoboards).

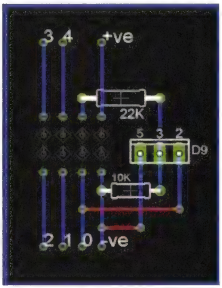
But as you can see, there is an awful lot of unused real estate on that board. Let's look at a couple of alternatives.

A one-third size breadboard (sold here in NZ as the Global EXP-325) just fits everything, (including the 3.6V NiCd battery – rescued from an old PC motherboard) we've become familiar with. It'll snap shut in a sealed food container for outdoor or submersed applications too, and of course a soldered version can be easily made too.

Something more permanent?

So you want a permanent version? Time to transfer your circuit to, say, a PC board?

During recent time with the "08",



Here's a stylised version of how a permanent hookup on Veroboard or similar might work.

References and parts suppliers . . .

(also refer to previous months articles)

1. Suitable NTC thermistor (R1895 100kΩ/25C), and PC prototyping board (H5605), assorted resistors, transistor & 500kΩ pot: Dick Smith Electronics www.dse.com.au
2. White LEDs, battery (3.6V 70mAh SB-1609 ~ A$9) and small piezo sounder: Jaycar Electronics www.jaycar.com.au
3. Humans perceive pulsing lights under "flicker fusion frequency" laws (Ferry-Porter etc) http://webvision.med.utah.edu/temporal.html
4. Mini EXP-325 protoboard (~A$5): www.globalspecialities.com
5. "Dataloggerama" insights are gained at www.rogerfrost.com
6. Picaxe supplies via MicroZed www.picaxe.com.au, with program listings and diverse links www.picaxe.orcon.net.nz
7. Thanks to Eltham Tech Centre and Andrew Hornblow (Taranaki, NZ) for DIY ideas.

and building on feedback from students, older hobbyists and emails, it's remained apparent that soldering should be the last thing you do when investigating such electronic circuits.

Maybe your design is unstable, draws too much current, has wrong colour LEDs or is even (duh!) too big for the box! Once soldered up these aspects may be a nightmare to alter without tedious redesign or desolder-ing, risking ESD or heat damage.

Solderless "breadboard" protoboards remain ideal for rapid PICAXE development (I'll use them again with the 18A), even though some of the tweaking can be of course via software.

Naturally, once your design is finalised, if you want to keep it then it's standard practice to produce a soldered version. If full PC board design costs and time are not justified, consider several rapid cost-effective approaches instead.

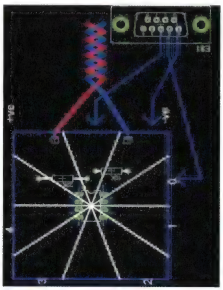
1. Many suppliers sell a pre-drilled $1/10^{th}$ inch grid board, with copper tracks matching a normal breadboard. It's almost "paint by numbers" to move items from one to the other and solder as you go, with the final result looking convincingly professional.

2. VeroBoard (and all its variations). The hobbyist's standby of course and is easily scored and cracked to size.

Considerable lateral thinking by NZ "BrightSparks", with minds refined by crosswords, it transpires, have produced soldered Vero versions to suit many "08" circuits.

In the most general form (which even includes a programming socket) only a tight block of track needs removal but a grander version even provides for driver transistor placement. IC header strip can be soldered in for flying leads too. Recommended !

3. Copper clad "spider board". Deep cuts made quickly and neatly across the copper produce ten sections (yeah, we know spiders have eight legs, not ten!) that suit top surface mount soldering of components and an IC socket, or even edge clipping of leads. It perhaps best suits junior users who need WYSIWYG insights. **SC**



Similarly, here's a "Spider Board" which you can make yourself with a sharp knife and scrap of PC board.

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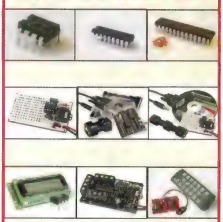

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Automotive lighting systems are about to undergo a revolution, from headlights that "see" around corners to tail-lights that vary according to the braking intensity. But that's not all – some important new safety features are in the pipeline as well.

By JULIAN EDGAR

Automotive lighting is undergoing a revolution. Not only are High Intensity Discharge (HID) and Light Emitting Diode (LED) light sources now being widely used but car lighting systems are also becoming increasingly intelligent. This "intelligence" ranges from headlights that swivel to "see" around corners to brake lights that illuminate by varying degrees, depending on how quickly the car is slowing.

Additionally, interior lighting is now being viewed by designers as having an important impact on the interior ambience of a car and so is being given the attention previously reserved for picking interior trim specifications.

Active headlights

While some Citroen models of decades ago used swivelling headlights, such an approach never became popular. However, headlights that actively move their illumination patterns are now being revisited – and the technologies being employed are far more sophisticated than ever before.

Audi's Advanced Front-Lighting System (AFS) is one approach and is expected to be introduced into production vehicles in the near future – in fact the most basic version of the system (cornering illumination) is already present on the Audi A8 luxury model, as well as on some other cars. However, the proposed systems are even more interesting - they will have the ability to start "shining" around corners even before the car begins its turn!

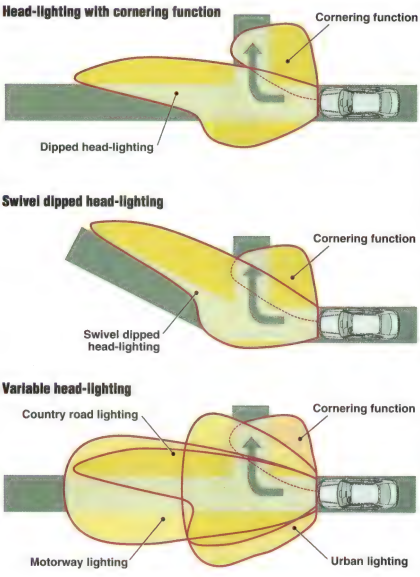
In the Audi system, the amount of side illumination that occurs when cornering is mainly determined by the steering angle. However, it also depends on the vehicle's speed. For example, Audi has decided that at motorway speeds, cornering illumination isn't as important as at slower speeds where sharper changes in direction are undertaken.

In addition, the turn indicators are also used to provide an early warning as to the driver's intentions. By then adding in speed information, the appropriate radius of the corner that the vehicle is about to negotiate can also be estimated. For example, a driver slowing down from 60km/h to 20km/h and indicating a righthand turn is probably about to negotiate a junction

with a small radius of curvature and so the headlights' illumination can be directed accordingly.

A "look ahead" cornering function can also be supported by the GPS navigation system. In addition to predicting the radius of the bend about to be negotiated, data from the navigation system can also be used to categorise the type of road that the car is moving along. This can be used as an additional input for deciding headlight range and when side lighting should be used; eg, to illuminate crossroads. Signals from light and rain sensors can also be used to switch on bad-weather lights or to produce a lighting pattern that reduces glare from wet roads.

As the final step in the implementation of these systems, Audi expects to introduce a variable light distribution function, where the shape of the low and high beams alters depending on the type of road. A low beam that automatically spreads when the car reaches junctions, increases in reach on country roads when there is no traffic coming the other way, and "looks" around corners can all be achieved. It should be noted that in luxury cars (in which these systems will first appear), nearly all of the input sensors already exist for this sophisticated approach to vehicle lighting – road speed, navigation, ambient light and, of course, the turn indicator function.



Audi's Advanced Front-Lighting System shows the approaches likely to be introduced over the next two years. From top to bottom: (1) cornering lighting which responds to steering lock and speed inputs; (2) headlights that swivel to illuminate around corners; (3) headlight beams that actively change shape depending on the driving environment. ***(Audi)***

The DaimlerChrysler system

While Audi has already introduced cornering lighting and are well advanced in their plans for actively moving headlight illumination patterns, DaimlerChrysler expect to launch mechanically moving headlights within 12 months. Developed in conjunction with Hella, the system will feature headlights that follow the driver's steering movements, swivelling in the corresponding direction as the vehicle enters a curve.

But just how beneficial would this be to night driving vision? DaimlerChrysler claims that when entering a curve with a radius of 190 metres, conventional dipped headlights are able to provide illumination for a distance of only 30 metres. By contrast, the corresponding distance for swivelling headlights is 55 metres!

The DaimlerChrysler active lighting system uses the HID headlight technology already widely used in Mercedes models. Electric motors are used to swivel each headlight, with the individual controlling microcomputers supplied with real-time information from the steering-angle and speed sensors. In addition, conventional (for HID lights!) active headlight levelling is used to reduce the chance of dazzling oncoming drivers.

US automotive parts manufacturer Valeo is also working on a similar system, which they have dubbed "Bending Light". Like the DaimlerChrysler system, Bending Light uses motorised headlights which swivel at angles determined by using inputs from the steering wheel angle, wheel speed sensors and (optionally) a GPS system.

However, German auto-maker BMW is developing a headlight system that is even more sophisticated. Their so-called "pixel headlights" use 480,000 individually-controlled and microscopically-sized mirrors to take over the reflector function. This approach allows the headlights' beam patterns to be precisely tailored to the driving conditions, allowing dazzle-free per-

Headlights which automatically change their beam width, angle and reach are all possible when inputs to the system include GPS. With nearly all luxury cars sold today fitted with integrated GPS navigation systems, such an approach is quite feasible. The safety benefits of this type of system would be enormous. ***(Audi)***

The BMW pixel light system, which is an ongoing research program of the German car maker, uses 480,000 individually-controlled microscopic mirrors in place of a conventional reflector. The shape of the beam is completely programmable. ***(BMW)***

manent high-beam illumination. It also allows specific headlight illumination patterns for bends, city environments, motorways and bad weather. Additionally, road lane markings can be illuminated with their own sub-beams.

BMW also somewhat bizarrely suggest that navigation instructions could be given to the driver by means of altering the pattern of lighting – eg, indicating a left-turn by replicating a left-turn arrow as part of the headlight beam.

One interesting potential stumbling block to the introduction of some aspects of these breakthrough headlight systems is legislation – many of the functions mentioned above are illegal in many countries!

Rear lighting

While not quite as startling as headlight development, rear lights are also undergoing major changes.

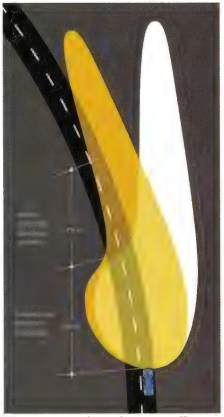
One area of development is in "intelligence" – making the rear lights automatically do what is required of them to improve their primary function of communicating with other road users. For example, the frequently forgotten or misused rear foglights can be almost immediately replaced with tail lights that vary in their intensity, depending on weather conditions. The light intensity will be highest for daylight fog or spray and lowest in clear night conditions.

Sensors built into the lights could be used to detect environmental conditions, contamination (eg, dirt) on the lenses and even the speed and separation of following traffic. The latter input can be used to decrease the brightness of rear lights working in "fog mode" as approaching traffic draws near. By using pulse width modulated LEDs, the tail lights' intensity can be easily and cheaply varied over a wide range. Typically, three times as much current is needed to provide adequate daytime illumination as at night.

Another intelligent technology is automatically flashing the hazard lights (ie, all indicators working simultaneously) after emergency braking has been detected (some cars already do this if an airbag deployment has been detected).

The currently clearly-defined shape of rear lights may also no longer continue. If matrices of LEDs are used to form the rear lights, their shape can be dictated by software commands, changing depending on the function being enacted (eg, brake light or indicator, or both) and even from model to model. The brake light can therefore vary in shape, depending on whether it is being used simultaneously with the reversing lights or alone, for example.

Finally, the surface area of a brake light that illuminates can be dictated by how fast the vehicle is slowing. BMW's concept car X-Coupe has brake lights in which only the outer rings illuminate under gentle braking. However, as the pedal pressure increases, the illumination spreads inwards until, under full braking, the entire area is illuminated.

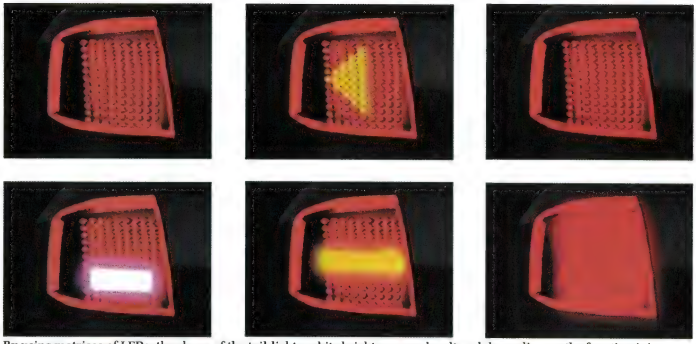


This diagram shows how swivelling headlights can dramatically extend the range of night vision. In this example, conventional dipped headlights are able to provide illumination for a distance of 30 metres in a curve with a radius of 190 metres; swivelling headlights add another 25 metres of range! ***(Daimler-Chrysler)***

Interior lighting

When you consider it, interior lighting in cars remains very primitive – the illumination of the instruments and controls is usually varied using just a manual brightness control, while the rest of the cabin is lit using only a couple of discrete lights. However, with less legal impediments standing in the way, changes in this area could occur very quickly.

In addition to the introduction of coloured LEDs, electroluminescent (EL) foils can be used to provide uni-



By using matrices of LEDs, the shape of the tail-light and its brightness can be altered depending on the function it is performing. This approach also allows model-to-model styling variations, software-driven changes from day to night and the use of a large and easy to see brakelight on all models. ***(Audi)***

form, glare-free lighting. Already used in the interiors of aircraft, EL foils are suitable for highlighting contours or uniformly illuminating strips. (EL foils are driven by an AC supply, meaning that some form of ballast is required – which in turn may have associated electromagnetic compatibility issues).

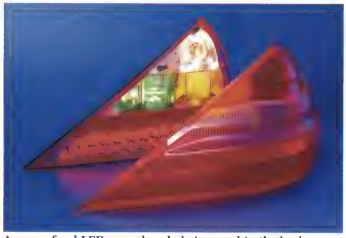
Fibre-optic light pipes are also starting to make inroads into cabin illumination – for example, the technology is ideally suited to illuminating from within the shift pattern on a gearknob.

The psychological aspects of in-cabin illumination are also being considered. For example, Audi suggest that at night and in dark environments, the interior lighting should create a perception of space, "so producing a feeling of well-being". When the car draws to a stop at night and the driver moves to leave the vehicle, EL strips could dimly illuminate the shape of the inner door, providing the same visual cues normally used when exiting in daylight.

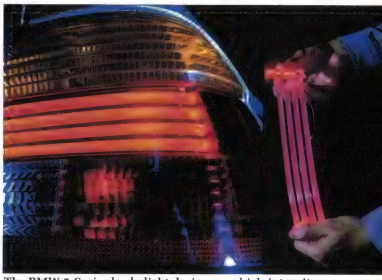
Such a "psychological" approach is already being taken on the Mercedes SL-Class. The interior of this car uses:

- Illuminated driver and passenger footwells, generating "a pleasant sensation of spaciousness";
- Night lights in the door handle recesses that light up the border indirectly, helping passengers to open the doors in the dark; and
- A lamp integrated into the housing of the rear vision mirror which casts a gentle light over the centre console.

To conserve energy (and to ensure that the right mood is created), a special sensor in the SL-Class detects

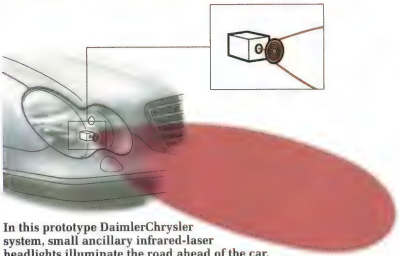


Arrays of red LEDs are already being used in the brake-lights of a number of cars. Their lower current consumption, faster illumination time and greater longevity gives them major advantages over traditional incandescent lamps. This is the rear light assembly of a current Mercedes SL-Class. ***(DaimlerChrysler)***

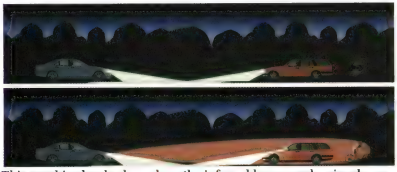


The BMW 5-Series brakelight design uses high-intensity LEDs that shine into optical tubes that stretch around the rear lights. ***(BMW)***

Laser Vision: Using Infrared To Overcome The Glare



In this prototype DaimlerChrysler system, small ancillary infrared-laser headlights illuminate the road ahead of the car. A video camera relays the image to a dashboard LCD screen which the driver can view. The infrared light is invisible to oncoming drivers, so the beams can be aimed much higher than would be the case with visible light. *(DaimlerChrysler)*



This graphic clearly shows how the infrared beam can be aimed much higher than conventional lights. Tricky time-referenced pulsing is used so that if the oncoming car is equipped with the same system, its video camera isn't blinded. *(DaimlerChrysler)*

This simulation shows how a pedestrian, normally invisible behind the glare of an oncoming car, can be clearly seen with the infrared laser system. *(Daimler-Chrysler)*

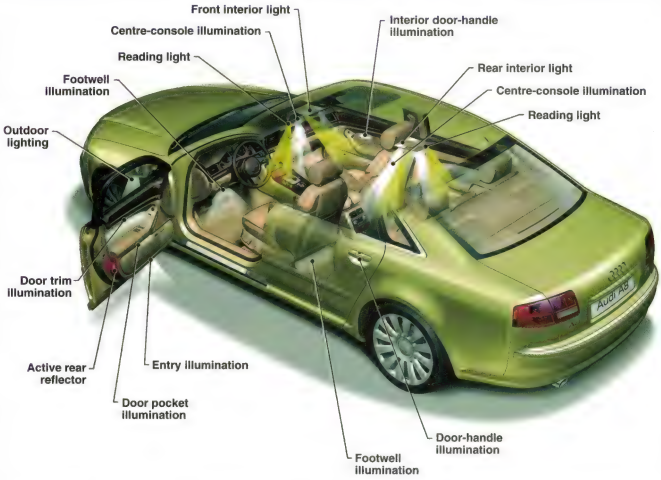
A limiting factor in all forward night vision is the capability of the human eye to distinguish objects, especially when being subjected to the glare of oncoming vehicles. However, if a quick check of a dashboard LCD screen could be made to see if that glimpsed pedestrian really is about to step off the edge of the footpath in front of the car, safety would be substantially improved.

At least one company, Daimler-Chrysler, is testing such a system. Four additional small infrared-laser headlights, a video camera mounted on the roof and an LCD screen mounted in the instrument panel comprise the visible parts of the system. Each laser is only pinhead in size and is matched with a special diffuser lens that ensures a wide, evenly distributed cone of infrared light. Because the infrared energy is invisible to oncoming drivers, the beams can be aimed much higher, helping to give the system a range that's nearly four times that of conventional low-beam headlights.

Another benefit of using a narrow-band infrared light source is that filters can be used over the video camera lens to reduce the glare of oncoming headlights. In fact, the blinding effect of these lights can be decreased by a factor of 50–100, while still allowing the reflected laser light to pass. In addition to this filtering technique, another approach is used to reduce the glare to which the camera is subjected. This involves pulsing the laser at 30 times per second, with each pulse being 8ms long. The video camera's shutter is tied to this pulse rate and with each dark period lasting three times as long as the bright period, interference from other light sources is minimised.

But what if the laser-light car meets another coming the other way? Won't the pulsing of the other car's laser system then have the wrong affect? Incredibly, the system takes this into account. Using precise time reference and compass direction signal inputs, the laser output pulsing is configured so that cars travelling in opposite directions have their laser pulses separated as widely as possible!

The DaimlerChrysler system is thus fundamentally different to other night vision systems that simply detect the heat energy given off by living objects. One big advantage of this system is that it can detect obstructions on the road that are at the same temperature as their surroundings.

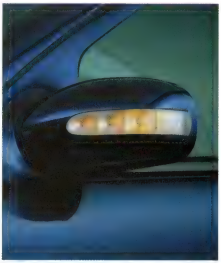


Interior lighting is becoming increasingly sophisticated as car makers strive to create the right psychological signals for relaxed night-time travelling, in addition to providing the basic required illumination. This Audi A8 has illumination of the door pockets, door handles (inside and out), door trims, footwells and the ground beneath the open doors – in addition to the normal instrument, controls and cabin lights! ***(Audi)***

Mercedes and Volvo vehicles are now being fitted with exterior entrance and exit lighting, switched on when the car is unlocked by the remote. This is a very effective approach and given that it costs little to integrate a light source into the underside of the rear vision mirrors, can be expected to be adopted by other makers. ***(DaimlerChrysler)***

ambient light levels, the electronic control module then using this input to determine the illumination intensity of the various interior lights.

In summary, the future for car lighting looks exciting. Intelligent front side-lighting, variable intensity taillights and more sophisticated cabin lighting are just three new automotive lighting technologies that you can expect to see on production cars in the near future. **SC**



DaimlerChrysler has almost standardised on the use of LEDs mounted in the rear vision mirrors for the side repeater indicators. The wraparound design allows both front and side recognition. (DaimlerChrysler)

September is packed with great bargains as well as a bunch of exciting new products and kits. You definitely don't want to miss these specials.
Remember, you can order any of these products (and 1000's more!) around the clock, from our secure online store at:
www.altronics.com.au

Jack O'Donnell,
Managing Director

Remote control your PC!

NEW

Great for watching DVD's or playing MP3's! It could even shut your PC down at the touch of a button!

(SC Aug' 03) Connects to your serial port and provides remote control of Winamp and WinDVD software as well as a host of other remote PC automation abilities.

$29.95
K 2755

BONUS DEAL! For just $10 extra, pick up an A 1013 remote control to suit. Valued at $36

CD Wallets with built in speakers!

NEW

Take your music anywhere with these great speaker / cd wallet combos. A fantastic sounding flat panel speaker plugs directly into your portable CD or MP3 player. All in one compact unit!
Mono holds 12CD's,10W. **Stereo** holds 24CD's, 20W

$28.95
A 9260 Mono

$48
A 9264 Stereo

Spending a fortune on AA batteries?

THIS CHARGER AND BATTERY DEAL WILL GIVE YOU UP TO A THOUSAND RECHARGES!

Pays for itself in no time! Suits NiCad or NiMH. Approx 7 hour charge time.

$18.75
A 0285

BONUS DEAL! For just $10 extra, pick up 4 x AA 2000mAh (S 4746A) batteries to go with your new charger. Valued at $22!

Keep on time while you stay in bed!

FANTASTIC NEW PRODUCT!
Projects the time onto your ceiling or wall! No need to get up just to check the time.
Features: • Alarm clock with snooze • Date display • 2 x AA battery (not supplied) powered for momentary projection

$29.95
A 0135

Rechargeable Batteries..

NEW

...save you money!
Don't waste a fortune on regular batteries! You can recoup the cost of these rechargeables in just 3 or 4 uses! Great for kids toys!

GOOD FOR UP TO 1000 RECHARGES!

Ni-MH Batteries	1 pack	2 Packs
S 4742A AAA 800mAh*	$9.95	$17
S 4746A AA 2000mAh*	$12.95	$22

** Supplied in packs of 2*

Quality Carbon Steel Cutters

Don't put up with cheap cutters that have blunt edges after only a few jobs!
High quality carbon steel cutters designed specifically for cutting solid core wires and small gauge steel wire

$14.50
Normally $19.95
T 2748

Batteries on charge at your desk!

BARGAIN!

POWERED BY USB!
Great idea for charging batteries powered directly off your computer. Charges a 600mAh AAA battery in 6 hours. Suitable for NiCAD or NiMH type batteries. Also has an extra USB port built in.
Supplied with 2 x AA 1400mAh and 2 x AAA 600mAh batteries!

NEW

$22
D 2380

FEATURE PACKED DJ MIXER!
FOR THE AMATEUR OR THE PRO

HOT PRODUCT!!!
At last a unit worthy of being called a "DJ quality mixer". This rugged, feature packed unit has many features you would expect to find on *"top end"* mixers costing up to 4 times the price! Sure to enhance your DJ'ing or provide hours of fun.
Features: • 3 band EQ (+20dB boost / -30dB kill)
• Cross fader • Invert switch • Crossfader curve adjustment (or hampster control) • Full band kill switches • Transform function • **M 9253** plugpack to suit $23.65

NEW

$225
A 2546

De-Solder Like a Professional!

Desolders a 14 pin IC socket in less than 30 seconds! Even on double sided PCBs!
Completely effortless desoldering. Features a fully automatic trigger system that provides continuous suction as long as the trigger is pulled.

WITH TEMPERATURE CONTROL & HIGH SPEED CONTINUOUS VACUUM ACTION!

$359
Normally $399
T 1260

True RMS Digital Multimeter

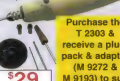
This professional DMM is ideal for R&D, service work and scientific applications. A long time tried and proven meter!
Features: • Dual display for frequency, AC voltage and temperature • 10 Location memory • Time mode with alarm, clock and stop watch • MIN, MAX, AVG and relative modes • Decibel measurement • Capacitance and inductance measurement • Temperature mode (°C/°F) • Pulse signal injection function for logic and audible testing, etc • Continuity and diode test • Logic test • Fused 20A input • Warning buzzer sounds when leads are incorrectly inserted in the 20A current mode • Data hold and run mode

SAVE $100!!

$220
Normally $320
Q 1098

Engrave your valuables!

A handy mini drill kit for engraving, craft projects, auto repairs, modellers and hundreds of other small jobs around the home!
Includes: Sanding sleeve, pcb drill bit, engraving bit & 2 cutting disks.



$29
Normally $31.45
T 2303

Purchase the T 2303 & receive a plug-pack & adaptor (M 9272 & M 9193) to suit valued at $17.55 for FREE!

Wireless indoor / outdoor thermometer

NEW

• 30m range • Wall or desk mount
• Temp range 0°-50°C • Ideal for remote temperature monitoring • Min/max memory
• Alarm clock with snooze

Monitor temperature in greenhouses, wine cellars, computer rooms, office air-con etc!

$45
A 0147

Regulated Bench Power Supply

Delivering 3V, 4.5V, 6V, 7.5V, 9V and 12V at up to 1.5A continuous capacity. Ideal for voltage sensitive devices like portable TV sets, video games, radios, scanners, computers.
Features short circuit and overload protection.

$30
Normally $49
M 8230

Ultrasonic Clean, Just Add Water!

SAVE $50!
This little gem cleans the tiniest delicate items without the risk of damage. Uses just a little water and the ultrasonic waves it generates for the perfect clean!

$149
Normally $199
A 0102

Great way to clean up precious jewellery in a FLASH!, without nasty solvents or abrasives!

Cordless Soldering Action!

This **120W** gas soldering iron offers **WIRE-FREE** convenience with a high capacity tank, giving you up to 4 hours soldering time per refill.

The T 2601 kit includes a T 2600 PLUS a protective carry case, wide range of tips & accessories including; cleaning sponge, solder dispenser, blow torch tip, air blower tip and hot knife.

$95
Normally $109
T 2600Iron

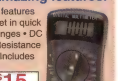
$129
Normally $159
T 2601Kit

Reel & Stand

Solder reel, iron holder and sponge all in the one compact unit! With weighted base for safety. Accepts 200g and 1kg rolls of solder. *(not included)*

$20
Normally $24.95
T 1306

Super Loud Siren



Hard wearing and absolutely **EAR SPLITTING** sound output. Great choice for home or car alarms. 12V, 120dB @ 1m.

$20
Normally $26.80
S 6130

Amazing price! Amazing features!

We couldn't cram any more features into this meter if we tried! Get in quick for these. ***Features:*** • 19 ranges • DC Volts • AC Volts to 600V • Resistance • DC Current • Data Hold • Includes high quality test leads.

Ideal for the budding enthusiast!

$15
Normally $19.95
Q 1121

Jumbo Display LCR Digi-Meter

Fully featured LCR multimeter providing capacitance and inductance measurements! Also crammed in is a 10MHz frequency counter, diode & transistor check, temp measurement and logic tester. Audible safety buzzer to prevent use when leads are in incorrect sockets.

Features • AC/DC current
• Continuity buzzer • Silicon rubber test leads and holster included
• Inductance • Capacitance
• Backlit display • Peak Min/Max

$135 Normally $159 — Q 1084

Limited Stocks of Tool Cases!

Rugged aluminium construction! Measures 460 x 325 x 150mm *Tools shown not included

Beware of interior quality cheaper models on the market which have plastic sides and are less robust.

$45 Normally $54.90 — T 5020

60W Professional Soldering Station

Top of the line with all the bells and whistles! Featuring a tip temperature display and quality Japanese ceramic heating element for rapid heat recovery.

Features: • Dual mode LED temp display • Zero-volt switching • Light weight ergonomic mini handle • Temp range 200 - 500°C • Temp lock facility • 4mm earthing point for anti-static strap

$250 — T 2438

FREE *Purchase the T 2438 & receive a free T 2439 solder holder and a 1kg roll of T 1115 solder (as shown) valued @ $40.55. At no extra charge!*

Replace 8 remote controls with JUST ONE!

Clear up the coffee table clutter with this bargain! Combines all your remotes into a single unit. Super easy to program. Gets you back to channel surfing in minutes! Features 32 storage keys for each device.

$55 Normally $68 — A 1008

12V 2A P/Supply (Regulated)

POWERFUL! RELIABLE!

Perfact for voltage sensitive devices like, scanners, CB radios, CCTV cameras etc., or even as a test bench power supply! Delivers a constant 12V DC regardless of current drain up to 2A.

$44 Normally $55 — M 6240

20MHz Dual Trace Oscilloscope

With the increasing complexity of electronic circuits a high quality oscilloscope is an absolute necessity for service techs & serious enthusiasts. ***Features:*** • 2 year warranty • Wide bandwith and high sensitivity • Very low power consumption • High sensitivity X-Y mode • Z axis (intensity modulation) • Simultaneous display of original and magnified waveforms on each input • Front panel electrical trace rotator • Regulated power supply circuit for accuracy • TV video sync • High frequency rejection filter in the triggering circuit

Includes 2 quality probes at no extra cost! Normally valued at $74.70!

SAVE A HUGE $224.70!
THOUSANDS in use with labs, schools, universities etc. THROUGHOUT Australia!

$649 Normally $799 — Q 0150S

SAVE A FORTUNE ON PREMIUM CABLE!

FIG "8" Cable

Heavy duty 24/0.20. Red/Black Only
***Full 30m roll only.**

50c/m* Normally .60c/m — W 2120

Shielded Fig "8"

Ideal for running audio leads around the house connecting wallplates etc.. ***Full 100m roll**

39c/m* Normally .48c/m — W 3022

Whopper Cable

***Full 50m roll only.** Get the sound quality your system deserves with this high power whopper cable

99c/m* Normally $1.80/m — W 2130

4 Core Security

Hook up your PIR's etc to your alarm system. White sheath. ***Full 50m roll**

45c/m Normally 0.60c/m — W 2346

Cat 5e & 6 Cable

HUGE 305m pull box for easy installation and neat storage.
Prices are PER BOX

Data Cable	Normally	NOW
W 2760 Cat 5e	75c/m	50c/m
W 2764 Cat 6	$1.62/m	$1/m

Buy a box and save a heap!

Drop proof announcers mic!

VIRTUALLY INDESTRUCTIBLE! Can be dropped repeatedly without damage. Ideal for schools.

AMAZING VALUE! Includes 5m XLR 3 pin balanced lead, typically valued at $22.95!

$40 Normally $52.50 — C 0383

THUMPING Subs!

HIGH POWER HEAVY-DUTY VENTED DOUBLE MAGNETS!

Incredible performance specifications. Kevlar impregnated pulp cone for efficiency and strength. High temp Kapton™ voicecoil with 4 layer winding for incredible sound reproduction and longevity.

$139ea or 2up $120ea Normally $159 ea — C 3049 4Ω 10 inch 500W Max.

$179ea or 2up $150ea Normally $199 ea — C 3051 4Ω 12 inch 600W Max.

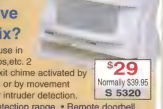
Full data sheet provided.

UHF Remote Control

This learning remote can be used to combine several remotes or replace an old broken one. Suitable for many older garage doors, car or bike alarms, home alarm, etc. • 4 buttons • Operating frequency 260-500MHz *Not suitable for any devices utilising 'code hopping'. Please check equipment before making your purchase.

$30 Normally $41.95 — A 1015

Need a quick inexpensive security fix?



Excellent unit for use in home, office, shops,etc. 2 modes: **1.** Entry/exit chime activated by an external switch or by movement **2.** Alarm mode for intruder detection. **Features:** 10m detection range • Remote doorbell contacts for monitoring two entryways • Ideal as a travellers intruder alarm or shop door bell. • 9V power.

$29 Normally $39.95 — S 5320

Cable Tie Gun

Automatically tightens up your cable ties with a simple pull of the trigger! Ideal for automotive work, production work etc. All steel construction, designed to last. Adjustable tension.

$45 — T 2346S

BONUS OFFER!
Receive a free 100 pack of 200mm cable ties (H 4022) with every T 2346 sold! Valued at $11.55

Take your data anywhere!

This tiny device (a mere 65mm long) can hold 256mb of data and simply connects to a spare USB port. Great way to transfer work from the office to home! No need for drivers in most cases! Supplied with strap and pocket clip.

$165 — D 0390

Fantastic headphone sound!

Great sound for your noggin doesn't have to cost a fortune! These hi-fi headphones have superior diaphragm drivers with samarium cobalt magnets! Supplied with 3.5mm stereo plug & 6.5mm adaptor.

$25 Normally $29.95 — C 9004

SLA Batteries

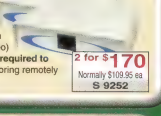
GET IN QUICK FOR THESE!

Premium grade long life, sealed lead acid batteries. *1000s sold to security companies across Australia!*

	Normally	1up	2up
S 5075B	1.3Ah	$24.50	$20ea	$15ea
S 5080	3.0Ah	$32.50	$25ea	$20ea
S 5090B	7.2Ah	$39.50	$30ea	$25ea

Use common Cat 5 to send video!

Why pay a fortune for long lengths of coax or video cable? When this little unit can transmit 4 channels of video for your security system up to 600m (B&W, 300m for colour video) via Cat5 cable! **Two units required to form a link.** Ideal for monitoring remotely mounted cameras.



2 for $170 Normally $109.95 ea — S 9252

EXPRESS
Overnight Delivery!*

NO RISK
14 day money back guarantee†

ALTRONICS

Digital Hygrometer & Thermometer

Simultaneously shows temperature as well as humidity. **Features:** • Min/Max memory • Suitable for desk or wall mounting • Wide temperature range

Monitor environmental conditions in greenhouses, wine cellars, computer rooms, office air con, aquariums etc!

$25 Normally $37.50 **A 0150**

Reduce Heatshrink with ease!

Reduces heatshrink quickly and effectively without burning it! Also great for bending plastics! Ideal for arts and crafts hobbyists; dries paint, glue and filler compounds.

Features: Regulated temperature • One-handed operation • Reliable piezo ignition • No direct flame

$29 Normally $36.50 **T 2480**

Mains power from a 12V car battery: ANYWHERE! ANYTIME!

Inverters are great for anywhere a remote power solution is required. The Powerhouse range comes in many different sizes suitable for different applications eg: 130W suits laptops etc.. while 720W suits power tools and small pumps. Ideal for tradesman, farmers, service vans, camping etc. All feature protection from incorrect polarity, over load, over temperature and short circuit.

130W Inverter 240V Modified Sine Wave 400W surge rated. With cigarette lighter plug

$99 Normally $109 **M 8102**

$169 Normally $219 **M 8116**

380W Inverter 240V Modified Sine Wave

CAN YOU BELIEVE IT? UP TO 1200W SURGE IN A VERY COMPACT UNIT!

Ideal for campers, RVs, 4WD, boats, trucks, farmers etc.

720W Inverter 240V Modified Sine Wave Ideal for anyone who needs to operate their tools away from a 240V outlet! 2000W surge rated.

GREAT FOR TRADIES PEOPLE!

$319 Normally $389 **M 8132**

Easy to read JUMBO display 32 range DMM!

The perfect working companion for the hobbyist, service or trades person. **Features:** Capacitance meter • Frequency counter • Resistance • Temperature test • Continuity tester • Auto power off • Measures up to 20A DC current & up to 1000VDC • Diode check

$69 Normally $99 **Q 1066**

SUPER VALUE! SAVE OVER 30%. Even includes a thermocouple!

180W Subwoofer Module

Enhance your sound system! Add a touch of realism to your favourite video or DVD!

Turn your lounge room into a cinema with your very own custom subwoofer. Self contained module is ideal for building into custom subwoofer cabinets. Fully featured,with volume, crossover frequency control, phase switch, high and low level outputs. Stable into 4 ohms.

$225 Normally $269 **A 2451**

An extra $50 gets you the speakers! A great package deal! For just $275 you get: **1 x A 2451 Subwoofer module 2 x C 3024 8" Woofers.** Valued at $405 normally! **SAVE $130!**

Glow in the dark keyboard!

See what your typing in the dark! 89 keys with the functionality of 104. USB connection With 6 special function keys. Great for lecturers and presentations in dark board rooms!

$95 **D 2114**

GLOWS BRIGHT BLUE!

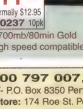
2 Way AV Switcher

Switches your TV's video input between 2 devices eg: game console & VCR.

$19 Normally $29.90 **A 3060**

HURRY, LIMITED STOCKS!

TDK BURNING BARGAINS!



$11.50 Normally $12.95 **D 0237** 10pk

700mb/80min Gold
High speed compatible

$9 Normally $1.95ea **D 0239** 5pk

700mb/80min
Great for CD backups!

NEW KIT RELEASES!

Convert your car dash to digital readouts!

(SC August '03) Converts an analog readout from a dashboard to a digital display. Ideal for replacing broken or faulty gauges. Suitable for fuel level, oil pressure or temperature readouts.

$59.95 **K 4375**

Turn all your gear on at once!

(SC July '03) Switch a whole bunch of appliances on with a single flick of a switch! Great for powering up your TV and home theatre equipment all at once! 1440W 6A power handling.

$69.95 **K 6046**

Use one in the workshop to start up a vacuum fan whenever your bench saw is used!

Get the most from your digital camera!

(SC July '03) This trigger kit senses the light from your bulit in flash and uses it to trigger a bigger external flash for more professional looking photos! Get the most from your camera!

$29.95 **K 8080**

Automate your lighting!

(SC June '03) Sunset switch kit designed to turn lighting or mains devices on or off at dusk or dawn. An optional timer can turn your lights off again between 15 minutes and 4 hours later.

$64.95 **K 6025**

Lets you know when your alarm triggers!

(SC April '03) Allows your alarm system to dial a number when its triggered. Can also be used on anything with closing contacts. Use it to notify maintenance staff when computer systems goes down. Also ideal for monitoring air con, pumps and cool rooms!

$64.95 **K 6230**

Add keypad entry to any room

(SC April '03) Add security to any room with this keypad entry kit. Easily interfaces to alarms or door strikes. Great for keeping the kids out of your workshop or study! Supplied without metal panel

$39.95 **K 1930**

ALTRONICS

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PRODUCT SHOWCASE

Microgram's Windows-Based Terminals

The new range of Windows-based terminals (WBT) have a 533MHz CPU at their core and a wide range of connectivity options. And, with the Aussie dollar having recently had something of a resurgence, they also have a new lower price.

They are suitable for use with Windows NT Terminal Server and Windows 2000 Server as well as supporting ICA and RDP protocols.

The terminals provide most popular text-based terminal emulations. They feature a boot ROM socket, smart card capability, PCI slot and are Windows CE.NET based. They have remote management facilities available in include PC card sockets. Full 32-bit colour is supported.

The three terminals in the range include one with a PC-card slot for Wireless Card and another with integral Smart Card Security.

There is all the connectivity you are likely to need: parallel port, two serial ports, two USB ports and PS/II ports for keyboard and mouse. Up to 17 emulations (including Wyse, DEC, IBM, TVI and ADDS) allow the terminal to access all kinds of mixed environments.

Recommended retail prices range from around $729.00

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1/14 Bon Mace Cl, Berkely Vale NSW 2261
Tel: (02) 4389 8444 **Fax:** 1800 625 777
website:www.mgram.com.au

Software and hardware discounts from NI

National Instruments has announced a 75% discount on all development software and toolkits for qualifying academic institutions, as well as a 10% discount on all hardware purchases.

National Instruments is dedicated to making educators and researchers more productive and improving the way students learn. In the work force, virtual instrumentation is becoming a valuable part of application development.

Students develop the skill set for such computer-based measurement and automation by using products such as National Instruments' LabVIEW, a graphical development environment.

National Instruments has also recently introduced NI Educational Laboratory Virtual Instrumentation Suite (**NI ELVIS**), a LabVIEW-based design and prototyping environment for university engineering and science laboratories. NI ELVIS enables students to simultaneously learn and practice engineering theory in areas such as electronics design, signal processing, communications, control systems, mechatronics, and instrumentation.

NI ELVIS consists of LabVIEW-based virtual instruments, a multifunction data acquisition device and a custom-designed benchtop workstation and prototyping board.

The key features of NI ELVIS include:

1. Integrated, multi-instrument functionality
2. Short circuit and high-voltage protection
3. Combined instrumentation, data acquisition, and prototyping station
4. Virtual instrument suite consisting of an oscilloscope, DMM, function generator, variable power supply, bode analyzer, arbitrary waveform generator, DSA, voltage/current analyzer
5. LabVIEW source code for all virtual instruments
6. Data storage in Excel or HTML
7. Detachable, customisable prototyping board.

Contact:
National Instruments
Tel: 1800 300 800
website:www.ni.com/info (au96bq)

Award no fluke . . .

The Fluke SureGrip accessory line has won a Silver Award in the annual Business Week magazine / Industrial Design Excellence Awards (IDEA). Celebrating the best product designs of the year from around the world, the American-hosted IDEA praised the Fluke SureGrip™ in the Medical and Scientific Products category.

Introduced earlier this year, SureGrip accessories include an eight-item line of ergonomically designed test lead clips, hooks, and pincers for electronic test and measurement.

Business Week magazine publishes an annual review of the best industrial design products from around the world. Fluke has also been recognized by leading design forums and is in the permanent collection of the Smithsonian's Cooper-Hewitt museum.

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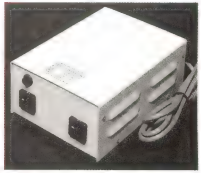


Harbuch Electronics Pty Ltd
9/40 Leighton Pl. HORNSBY 2077
Ph (02) 9476-5854 Fx (02) 9476-3231

Even robots need protection from the cold ...

Assembling pallet loads of cartons in distribution applications is a highly labour-intensive and physically demanding task in even the best of conditions.

So imagine how much more difficult this process would be in a freezer environment.

Eight people at dairy products manufacturer Crossroad Farms Dairy production facility outside Indianapolis (USA) previously handled palletising in the freezer, which operates at between -12° and -18° Celsuis.

Staff turnover in the freezer was high and workplace safety was difficult to maintain.

To eliminate the need for people to work in such an arduous environment, Siemens Dematic recently developed an automated palletising solution, an integrated material handling system incorporating three articulating arm robotic palletisers.

While the robots' electronics would be unaffected by the extreme cold, it was necessary to fit each robotic palletiser with heated Kevlar jackets to keep the necessary lubricants pliable.

The entire system is controlled from an external "warm" room by one technician, via video cameras and real-time system monitoring and maintenance software.

The robotic palletisers handle up to 45 cases/minute and typically operate for 16 hours a day.

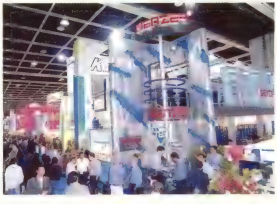
In Australia, Siemens Dematic has designed integrated robotic palletising systems for a number of manufacturing and distribution applications for companies including Carter Holt Harvey and Australia Meat Holdings.

Contact:
Siemens Dematic
24 Narabang Way, Belrose NSW 2085
Tel: (02) 9486 5555 **Fax:** (02) 9486 5511
website: www.siemensdematic.com.au

Hong Kong Electronics Fair on next month

The 2003 Hong Kong Electronics Fair, to be held at the Hong Kong Convention and Exhibition Centre from October 13 to 16, will boast a wide selection of advanced electronic products.

It continues to reach new levels of success every year. The 2002 Hong Kong Electronics Fair attracted 1,740 exhibitors from 22 countries and regions and over 47,000 buyers from all over the world, again breaking records of its own. With the lifting of the World Health Organisation's travel advisory against visiting Hong Kong, the 2003 show is expected to be very popular with visitors and exhibitors, perfectly timed to allow international buyers to check out the latest samples and to replenish stocks.



Hong Kong continues to be the major supplier of electronic products to the world and Hong Kong Electronics Fair, the premier show in the region, is the power switch that turns on unlimited trading opportunities for suppliers. Hong Kong exported a total of US$27.4 billion worth of electronic products in the first four months of 2003 – an encouraging growth of 21% over the same period last year.

1800 exhibitors will cover audio & visual products, electronic accessories, personal electronics, home appliances, multimedia, electronic gaming, office automation and equipment, related services, security equipment and telecommunications products.

Contact:
Hong Kong Electronics Fair
Tel: (HK)22404030 **Fax:** (HK)25986737
website: http://hkelectronicsfair.com

Energy chain

The igus energy E2/000 energy chain has various functions to provide optimum protection for cables and hoses without compromising flexibility in the day-to-day movement of cables.

The system can be opened up in the inner or outer radius, or 'half' the energy tube can be opened up in the inner radius and completely closed in the outer radius.

This is particularly useful in machine and plant engineering where high speeds are encountered, sophisticated energy is used alongside data, hydraulic and pneumatic equipment.

A break-proof opening mechanism can be used to open up the system from either the right or left hand sides. Opening clips can also be swung out more than 180° to provide undisturbed access to the energy supply system.

Openable by hand or by screwdriver, the igus E2/000 has a new type of mechanism allowing a split second closing operation and a secure fit without using any additional locking devices – it is simply locked down by thumb pressure.

Integrated fixed or pivoting connecting mounting brackets simplify on-site installation.

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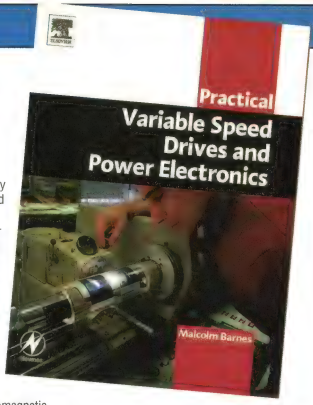
Unit 38, 9 Powells Rd, Brookvale 2100
Tel: (02) 9907 1788 Fax: (02) 9907 1778
website: www.treotham.com.au

Practical Variable Speed Drives and Power Electronics, by Malcolm Barnes. 1st Edition, February 2003, Butterworth-Heinemann. Soft covers, 262 x 194mm, 288 pages. ISBN 0 7506 5808 8. $88.00 including GST.



For years there has been a dearth of text books about motor speed control. And while SILICON CHIP has published a number of speed controls in the past, they have been mainly intended for universal motors (ie, series-wound motors with brushes and commutator). We have no answers for the many queries involving speed control of induction motors, whether single phase or 3-phase types.

The particular problem of induction motors is that they are essentially locked to the mains frequency, with the torque and power output being proportional to the "slip" between the motor's rotating field (produced by the stator windings) and the rotor itself. This means that if you want to control the speed of an induction motor, the frequency of the mains input and the voltage needs to be varied over a wide range. This cannot be done with simple circuitry. In essence, you need to rectify the incoming mains voltage (single phase or 3-phase) and use what is effectively a variable-frequency variable-voltage inverter to drive the motor.

The above information is vital for anyone wanting to use an induction motor to drive machinery over a wide speed range and even more important in traction control in solar powered and electric cars.

All of which makes this just published book written by Malcolm Barnes very welcome. We should state at the outset that this text does not give information which will allow you to design an effective induction motor speed control but it will give you a very good understanding of how induction motors and variable speed drives work.

The book is divided into nine chapters, as listed below. The first chapter is an introduction to the subject and covers the various types of mechanical drive, including belt, chain, friction, hydraulic and electromagnetic couplings. It concludes with a short description of electrical variable speed drives such as the schrage motor (movable brush), Ward-Leonard, SCR speed controls and variable speed drives of various types, including cyclo-converters.

Chapter 2 covers 3-phase induction motors very comprehensively. Not only does it explain induction motor operation, it discusses efficiency, motor rating, duty cycles, cooling and ventilation and motor selection.

Chapter 3 is entitled "Power electronic converters" and covers all the major active and passive components used in power electronics such as diodes, thyristors (SCRs), 3-phase bridge rectifiers, thyristor bridges and various inverters which can be based on GTO SCRs, Mosfets, bipolar transistors (BJT) or insulated gate bipolar transistors (IGBT). This is really the kernel of the book.

Chapter 4 is devoted to electromagnetic compatibility (EMC) and covers all the different forms of electromagnetic interference as well as motor protection from the high voltages and leakage currents in cables which are side effects of the PWM techniques used to synthesise a sinusoidal driving waveform.

Chapter 5 carries on that theme and is entitled "Protection of AC converters and motors". It talks about under and over-voltage protection and thermal overload protection. Chapter 6 is on "Control systems for AC variable speed drives", including open loop, closed loop, cascaded closed loop and vector control.

Chapter 7 is on the "Selection of AC converters" and discusses the loads on motors caused by machinery such as conveyors, compressors, pumps, fans, lathes, presses, saw mills and so on. You need to know all about the torque speed curves of your machine load before you can select the motor and its variable speed drive (VSD).

Chapter 8 is on "Installation & Commissioning" and discusses the physical installation as well as cabling, contactors, ventilation, serial communications and so on.

Finally, chapter 9 briefly discusses soft switching and matrix converters. There are also a number of appendices, on motor protection (direct temperature sensing), current measurement transducers, speed measurement transducers, international and national standards and a glossary.

In summary, this is a very useful book. It is an essential reference for engineers and anyone who wishes to design or use variable speed drives for induction motors. It will be available from the SILICON CHIP bookshop.

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Last month, we gave the circuit details for our new Digital Instrument Display and showed you how to build it. This month, we describe how to connect different sensors to the unit and give the calibration details.

Digital Instrument Display For Cars

Pt.2: By JOHN CLARKE

FIG.4 SHOWS THE TYPICAL sensor and meter connections as found in a vehicle. Generally, the sensor is grounded and the existing analog meter connects in series with this to a regulated supply. The other possible configuration is when the meter itself is grounded and the sensor connects to the regulated supply instead.

In either case, you can connect to the junction of the sensor and the meter (marked with an 'x') to obtain a signal for the Digital Instrument Display.

Alternatively, the sensor can be rewired as shown in Fig.5, using a fixed resistor (R1) to replace the meter. Note that R1 can be installed on the microcontroller board.

It is important to note that the Digital Instrument Display is designed to accept a signal voltage at its input which is within a certain range. So you will need to make some measurements to check whether the voltage range from the sensor is suitable. If the signal voltage is outside the limits, it can be tailored using several adjustments at the input to make it suit.

The voltage limits for the Digital Instrument Displays input are as follows:

(1) with R3 out of circuit, the unit can be used with voltages ranging from 0.5-4.5V.

(2) with R3 in circuit and VR1 adjusted so that the unit can read down to 0V, the Digital Instrument display can measure up to 2.7V when VR2 is fully clockwise (250kΩ) and up to 3.4V when VR2 is fully anticlockwise (0Ω).

Attenuating the input voltage

The value of R1 (see Fig.5) needs to be selected so that the voltage across the sensor remains within the allowable range. Typically, R1 would be a 330Ω (0.25W) resistor and the circuit would be configured with VR2 fully anticlockwise, R3 in circuit and R2 omitted.

However, if the sensor voltage goes above 2.7V, you can adjust VR2 so that signal voltages up to 3.4V can be monitored. Higher input voltages will need to be attenuated by fitting resistor R2.

R2 can be calculated if the maximum input voltage (Vin max.) to be applied to the input is known. The circuit for the attenuator is shown in Fig.6. If VR2 is set at its mid-position, the value for R2 = 30kΩ/(Vin max. - 3).

For example if the maximum input voltage is 8V, R2 will be 30kΩ/5 or 6kΩ. A 5.6kΩ resistor would be suitable. VR2 is then used to adjust the range of the signal voltage that can be applied to the circuit.

Trimpot VR1 will require adjustment if resistor R3 is installed. Also,

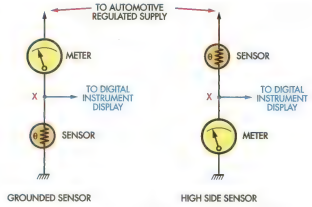

Fig.4: typical sensor and meter connections as found in a vehicle.

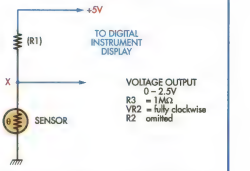

Fig.5: R1 needs to be selected so that the voltage across the sensor remains within the allowable range. Typically, R1 would be a 330Ω (0.25W) resistor and the circuit would be configured with VR2 fully anticlockwise, R3 in circuit and R2 omitted.

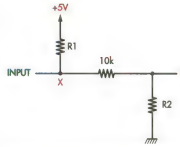

Fig.6: resistor R2 is necessary only if the signal voltage (ie, from the sensor) goes above 3.4V. Its value is calculated as described in the text.

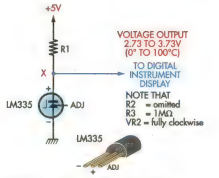

Fig.7: how to use the Digital Instrument Display with an LM335 temperature sensor (see text).

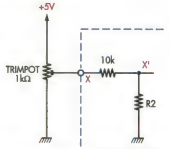

Fig.8: a 1kΩ trimpot connected between the +5V rail and ground can be used to set input voltages to calibrate the unit.

this adjustment will need to be redone if VR2 is altered.

In practice, VR1 is adjusted by connecting the input to the Digital Instrument Display to 0V and selecting the input mode by pressing the Mode switch four times (ie, four times from the normal display position mode). **Note, however, that VR1 is NOT adjusted for a display reading of 0 (if it does show 0, then trimpot VR1 is too far clockwise). Instead, adjust VR1 so that the display shows a reading between about 97 and 110.**

Fig.7 shows how to use the Digital Instrument Display with an LM335 temperature sensor. Typically, the output from the sensor varies by 10mV/°C, with the output at 2.73V at 0°C.

Calibration

We have already described how the calibration modes are accessed by pressing the Mode switch. As previously stated, calibration is performed at two different points and the instrument then calculates the readings for the remaining input voltages.

Before starting calibration, you must first decide on the display readings that are required at these two points. For example, for a temperature gauge, you might select 0°C and 100°C for the two calibration points. Alternatively, for a fuel gauge, you could calibrate the unit at 10 litres and 50 litres.

These values are then entered as the first and second calibration numbers. Note that the first calibration number must correspond to the lower of the two voltages applied to the instrument during calibration. So, taking our first example, if the sensor gives a lower signal voltage at 0°C than at 100°C, then the 0 is entered into the first calibration position and the 100 is entered into the second calibration position.

Alternatively, if the sensor gives a lower voltage at 100°C compared to that at 0°C, the 100 must be entered into the first calibration position and

Installing The Unit In A Vehicle

Use automotive cable and connectors when installing the Digital Instrument Display into a vehicle. The +12V supply connection is derived via the ignition switch and a suitable connection point will usually be found inside the fusebox. Be sure to choose the fused side of the supply rail, so that the existing fuse is in series with the unit.

The ground connection can be made by connecting a lead to the chassis via an eyelet and self-tapping screw.

Similarly, use automotive cable to connect to the chosen vehicle sensor or sender unit.

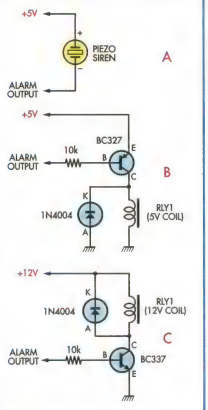

Fig.9: here's how to use the alarm output: (A) low current piezo siren; (B) driving an external 5V relay; and (C) driving an external 12V relay. Note that in (C), the alarm sense must be reversed (during calibration) so that a high alarm output drives the relay (see text).

the 0 into the second calibration position.

The same applies for a fuel gauge or oil pressure gauge – ie, use the figure that gives the lowest signal voltage in the first calibration position and the figure that gives the highest signal voltage in the second position.

Calibration signals

In order to calibrate the unit, you need to feed in a signal voltage that's the same as that provided by the sensor at each calibration point. To do this, you can either use the actual sensor itself or you can use a 1kΩ trimpot connected to the input as shown in Fig.8.

As mentioned before, the two calibration positions are selected using the Mode switch. If the first calibration position is to be calibrated, apply the calibration voltage, then select this position by pressing the Mode switch once after the "normal" mode.

Now wait for several seconds for the voltage at the input to be measured by the Digital Instrument Display. **Now press the Up switch and then the Down switch, so that the value is the same as before. This needs to be done as calibration can only take place when the calibration value is changed.** Simply selecting the calibration value with the Mode switch will not calibrate the Digital Instrument Display.

The second calibration voltage is then applied and the Mode switch pressed again to show the second calibration number. Wait a few seconds, then press the Up and Down switches to calibrate this value.

Note that there is no need to feed in both calibration values at the same time – calibration can be done for either the first or second position at any time (even weeks apart if that's more convenient).

In fact, if you are calibrating the unit for a fuel sensor, the best approach is to calibrate it for one value when the tank is full and then wait until the tank is almost empty to feed in the other calibration number.

Alternatively, you can do this the other way around – ie, feed in one calibration number when the tank is empty, then fill up and feed in the other calibration number.

Note that the "normal" readings will not be correct until both calibration values have been entered.

Checking signal levels

It's important to check that the voltages applied to the Digital Instrument Display are not beyond its range. This can be done by pressing the Mode switch four times from its normal display mode to select the input reading mode. The display should show a value between about 100 and 940. Values much below 100 will go to "0" and values much above 940 will show "FUL" on the display.

A "0" or "FUL" indicates that the voltage applied to the Digital Instrument Display is out of range and the voltage will need to be altered as previously described using R1, R2, VR1 and VR2.

Measuring sensor voltages

Calibration of the instrument with a fuel or oil pressure sensor can initially be done by measuring the voltage across the sensor in its standard form when connected to the original analog meter. You will need to connect your multimeter so that the measurement can be made over the full range of outputs from the sensor during normal running of the car. This way, you will gain a good idea of the voltages that are produced by the sensor.

During this time, record two voltages that correspond to two particular markings on the meter. The further apart the voltages are, the more accurate the calculation for other values will be.

Be sure to check the voltages obtained during this process against the allowable limits. You can attenuate the level using R2 if the voltage range from the sensor is too great. Similarly, if the voltage goes below 0.5V, you will need to install R3 and then adjust VR1 as detailed above.

You can then calibrate the instrument using the voltages found by measurement and by using a 1kΩ trimpot connected as shown in Fig.8. That done, disconnect the car instrument from its sensor and measure the instrument's resistance to determine the value of R1. It's then just a matter of installing R1 on the microcontroller board, as shown in Fig.5.

Temp. sensor calibration

Calibrating the unit for use with a temperature sensor can be done at 0°C and at 100°C The 0°C calibration is done using freshwater ice which is stirred in a small amount of cold fresh water. Stir the solution with the sensor immersed in it to ensure it reaches the 0°C of the water/ice solution before entering "0" for the first calibration number.

Note that if you connect a multimeter across the sensor, it will stop changing value when it reaches 0°C – ie, it will reach either a minimum or maximum output.

By contrast, the 100°C calibration is done by immersing the sensor in boiling fresh water. Again ensure that the sensor output has stabilised in the boiling water by monitoring its output voltage before entering in the calibration number.

Just remember that the calibration number corresponding to the lowest sensor voltage goes in the first calibration position. So if the sensor voltage

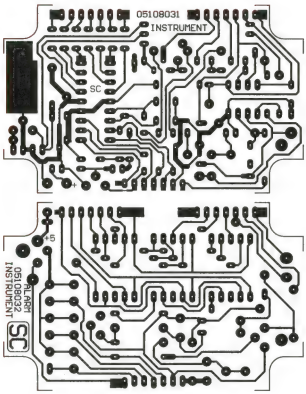

Fig.10: here are the full-size patterns for the two PC boards, together with the full-size front-panel artwork which can be used as a drilling template. Check your PC boards carefully for defects before installing any parts.

at 0°C is lower than at 100°C, then "0" goes in the first calibration position and vice versa.

Once calibrated the instrument will display values based on a calculation that assumes a straight line (linear) relationship between the two calibration points. It will also calculate the values outside the two calibration points, again assuming a linear relationship.

For example, when connected to a temperature sensor, the display will show temperatures below 0°C when the sensor is colder than this and also above 100°C if the sensor is hotter than this value. In fact, the display can show values between -99 and 999 but, in practice, may be restricted to a range that's less than this, depending on the signal voltages applied to the unit and the voltage excursion of the sensor.

Using the alarm output

The alarm is set to the required value by first pressing the Mode switch three times from the "normal" mode position. You then set the value using the Up and Down switches and select the sense as described earlier. The latter determines whether the alarm activates as it goes above or below the calibrated value.

The alarm output goes low under alarm conditions and this lights the alarm decimal point in DISP3. In addition, a low-current piezo siren could be connected between the +5V supply and the alarm output if an audible alarm is required – see Fig.9(a). The Jaycar AB-3462 piezo siren would be suitable, as it draws less than 15mA when used at 5V.

Fig.9(b) shows how to connect an external relay to the alarm output. You need to build up a small circuit consisting of a 10kΩ resistor, a BC327 PNP transistor and a diode. The relay needs to be a 5V or 6V type since it is powered from a 5V supply.

Alternatively, the circuit shown at Fig.9(c) can be built. This circuit can drive a 12V relay but note that the alarm sense will have to be reversed (ie, during calibration), so that a high alarm output drives the relay rather than the normal low output level. In addition, you will have to delete the visual alarm indication, since this will no longer be valid. This simply involves removing resistor R6 to disable the decimal point indication in display DISP3. SC

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VINTAGE RADIO

By RODNEY CHAMPNESS, VK3UG

Vibrators: the death knell of heavy, expensive dry batteries; Pt.1

Vibrator-operated power supplies were well-established by the mid 1930s, being used initially in car radios and later in domestic battery-powered receivers. Here's a look at how they work.

Vibrators were developed rather early in radio history and were first used in telephone exchanges in one form or another. However, they were not used in radios until the advent of the car radio.

Car radios were initially very similar to ordinary domestic battery-powered radios. That meant that they used a low-voltage accumulator for the "A" supply for the valve filaments (or heaters) and a string of HT batteries for the high-voltage "B" supply. However, manufacturers quickly realised that lugging a large domestic style set and a bank of batteries into a car was hardly likely to catch on with the general public.

This photo shows HMV's 2V vibrator power supply with the covers on. Note the shielded power supply leads which were necessary to reduce interference.

The problem had to be attacked on two fronts. First, car radios had to be made relatively small, they had to be sensitive enough to work from a small aerial and they had to be rugged enough to withstand being jolted. This was quite a challenge which significantly exercised the talents of car radio designers.

Second, manufacturers had to devise a better method of supplying the filament\heater voltages and currents, and the high voltages necessary for the valve anodes and screens. And that meant getting rid of all the extra batteries and relying solely on the vehicle's battery instead.

6.3V heaters

During the early 1930s, valves came with all sorts of different heater/filament voltage ratings. However, cars in the USA at that time used a 6V battery. As a result, many valves were redesigned so that their filaments/heaters could be run from 6.3V which meant that the vehicle's battery could be used.

For example, the 6A7 was produced as a 6.3V heater version of the 2A7 (2.5V heater). Why 6.3V? – well, a 6V battery has three cells and these produce around 2.1V per cell, or 6.3V total.

Of course, it was also quite practical to use the 6V heater valves in domestic battery-operated and AC mains-operated sets as well as car radios. So 6.3V heaters quickly gained widespread popularity.

As an aside, filament valves (ie, valves with directly heated cathodes) were initially tried in car radios but were found unsatisfactory for two reasons. First, the filaments were rela-

Vibrators – How They Work

A vibrator, or vibrator cartridge, is a plug-in device, somewhat similar to a valve and made that way for much the same reason; it had a limited life and was expendable. It even used a standard valve socket, different types using 4-pin, 6-pin and 7-pin sockets.

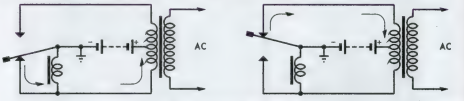
By using a vibrator, it was possible to make a radio power supply which required only one battery. Compared to a straight battery receiver with 135V of dry cell batteries, a vibrator set was a lot cheaper and more convenient to run, if one had the means to recharge the battery.

In practice, the vibrator's task is to change the low DC voltage from the battery into low voltage AC, in the form of a square wave at approximately 100Hz. This is done by using two sets of electrical contacts mounted on each side of a vibrating reed. The vibrating part is similar in construction and operation to an electric buzzer or bell.

The vibrator contacts switch the DC voltage alternately between opposite ends of a centre-tapped transformer, so that the current flows alternately in opposite directions through the primary – see Fig.1.

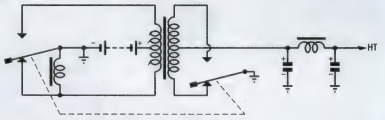
After transforming the switched DC to a higher voltage, it must then be rectified and effectively filtered to smooth DC before it can be used as a hum-free high-tension voltage. This can be done in several ways.

One way is to use a rectifier valve as would normally be used in a mains-operated receiver. The type of vibrator that uses a separate rectifier has two sets of switching contacts and is known as a non-synchronous vibrator.



NON-SYNCHRONOUS VIBRATOR
REED CONTACTS NOT SHOWN

Fig.1: basic scheme for a non-synchronous vibrator. The vibrator contacts switch the DC voltage alternately between opposite ends of a centre-tapped transformer, so that the current flows alternately in opposite directions through the primary. The resulting AC output was then fed to a rectifier.



SYNCHRONOUS VIBRATOR
RF INTERFERENCE SUPPRESSION COMPONENTS NOT SHOWN

Fig.2: the synchronous vibrator arrangement. This type of vibrator employed a second set of contacts which were used to mechanically rectify the high tension current in conjunction with a centre-tapped transformer secondary.

The non-synchronous vibrator was usually used in valve car radios, together with an ordinary AC-type rectifier valve. In car radios, power consumption was of little consequence and they normally used AC-type valves throughout.

Domestic vibrator radios were usually more economical in their operation and used mostly battery valves and a synchronous vibrator which has two additional sets of contacts inside it. These extra contacts were used in conjunction with a centre-tapped transformer secondary to mechanically rectify the stepped-up voltage and thus produce the HT without using a rectifier valve – see Fig.2.

Of course, the resulting HT rail required very effective filtering to eliminate the considerable amount of "hash" that would otherwise have been produced. Note too that the vibrator cartridges usually had a limited life. Even so, replacing the odd vibrator unit must have been considerably less expensive than paying for all those dry cell batteries.

tively fragile and often created microphonic noise in the receiver's output. In addition, the car's electrical system and the equipment connected to it (eg, the ignition system) produced a lot of noise which was difficult to filter out of the filament supply.

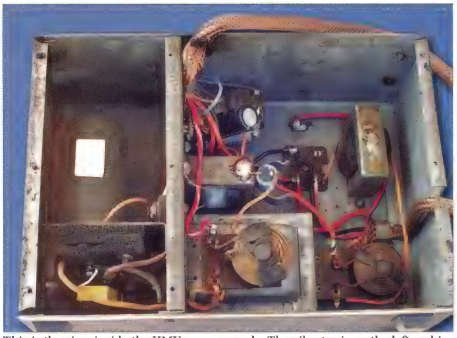
HT voltages

Having solved the low voltage supply problem, the high tension (HT) voltage had to be obtained – again from the car's battery if possible. At this time, there were three different methods that could be used to supply the HT voltage: (1) dry batteries, (2) genemotors and (3) vibrators.

The first two methods were well-established and worked well, except that batteries were bulky and expensive, while the genemotor was expensive, mechanically noisy and inefficient. Vibrators were also being used in cars around 1932 but were in need of development to make them more reliable.

In fact, reliability was their main disadvantage at that stage. However, the reliability was improved and vibrator power supplies were well-established in car radios in America by 1935. However, they never quite achieved the same reliability as batteries or genemotors.

On the other hand, vibrator power supplies did prove to be efficient, economic and reasonably reliable as design improvements occurred. Their relatively low cost also meant that it was quite economical to replace them as you would a valve, as both are "plug-in" items (except for very early



This is the view inside the HMV power supply. The vibrator is on the left and is enclosed in a rubber "sock" (marked with a white sticker). A rubber-mounted socket is also used for the vibrator, to further reduce mechanical noise.

in their development).

That said, the vibrators in some of my sets have never required replacement, despite a lot of use since 1944. This proves that very good results were achievable provided the power supply was correctly designed.

Vibrators in domestic radios

Having got car radios off to a good start with vibrator power supplies, the manufacturers decided to see if domestic battery-operated sets could be run from them as well.

Although efficiency was not of paramount importance in car radios, vibrator sets intended for use in the home had to draw as little current from the battery as possible. This was necessary so that the battery didn't have to be recharged more than once or twice a month. Remember, many country homes did not have electricity connected in the 1930s, 1940s and 1950s.

Most battery-operated sets during this era had a 2V lead-acid cell (battery) for the filaments, three 45V dry batteries for the HT and maybe a bias battery as well. The owners of these sets were prepared to have the 2V cell charged about once a month at the local garage and garages in country towns did quite good business doing just that.

The manufacturers soon realised that if they made a vibrator "power pack" that ran from 2V, it could run be run from the 2V cell (battery) and supply the high voltage normally provided by the three 45V batteries. This would save owners from having to buy expensive 45V batteries.

Unfortunately, these vibrator supplies were not very efficient due to the low supply voltage. Nor did they have a very high output.

The Oak V5289 split-reed vibrator was a typical example. It was designed to power the HMV 601 battery valve set, draws 1.2A (which includes the filament current) and weighs in at a hefty 3.5kg.

1.5V vibrators

Around 1940, the Americans experimented with an even lower voltage vibrator power supply. It was designed to run from a 1.5V No.6 cell and provided 90V at 9mA for a set using the relatively new 1.4V filament valves. Interestingly, an article on this appeared in "Radio & Hobbies" at the time.

Whether or not these 1.5V vibrator supplies were ever put into production is unknown. In fact, the "Radio & Hobbies" article expressed doubts about the viability of running a vibrator supply from a No.6 cell.

That's because the vibrator supply and the filaments in a 4-valve receiver would draw around 1.2A from the cell, assuming that the vibrator supply had an efficiency of 65%. A No.6 cell has an amp-hour capacity of 17-30Ah, depending on the load. And that meant a battery life of just 10-20 hours, depending on the usage per day.

Although the article stated that the supply was "quite free of both mechanical and electrical hum", no mention was made about vibrator hash interference. The circuit, shown in Fig.3. was quite basic and had virtually no RF filtering, so it was probably capable of causing significant interference to the receiver.

Vibrator-powered house sets

The next step by the manufacturers was to design vibrator receivers that operated from a 6V lead-acid "radio battery" (or deep-cycle battery). Of course, it was necessary to keep the current drain down, so that the 6V battery only needed recharging once or twice a month with normal use. Some farmers charged their 6V radio batteries from a car or truck electrical system, while others had them recharged at the local garage.

However, not all battery-powered receivers used a 6V battery. A few used a 4V battery and even fewer used a 2V cell.

Vibrator power supplies

Most restored vintage radios are mains-operated. As a result, many collectors are either familiar with the operation of this type of power supply or, at the very least, know how to check that it is functioning correctly.

A mains power supply is quite straightforward and usually includes a transformer with at least three windings: the 240VAC primary winding, a 6.3VAC heater winding and a centre-tapped high tension (HT) winding. This is followed by a full-wave valve rectifier, usually followed by a filter choke, two electrolytic filter capacitors and perhaps a back bias resistor.

The power supply for a battery-operated set is even simpler, consisting purely of batteries that need replacing all too often – usually at considerable expense. No maintenance is required for such a supply other than battery replacement.

By contrast, a vibrator power supply is much more complicated than a

mains power supply. It uses a vibrator and a step-up transformer as the essential components of the supply. The vibrator is usually employed to act as an electromechanical rectifier as well as a generator of square-wave AC voltage.

By using a synchronous vibrator - see Fig.2 – to achieve this function, designers could save on the cost of a rectifier and the heater power that it used (a 6X4 rectifier valve uses nearly 4W of heater power).

As well as the vibrator, it was also necessary to have the usual high-tension (HT) filters – ie, electrolytic capacitors and a filter choke. It's also worth noting that the low-tension (LT) supply to the valve filaments had to be well filtered to remove any ripple that would otherwise be caused by the vibrator's operation. This typically involved using an iron-cored filter choke with a very low resistance winding, along with a couple of low-voltage electrolytic capacitors wired in a similar configuration to the HT filter system.

Additionally, sparking at the vibrator points – although minimal in a well-designed vibrator power supply – created RF interference. To combat this, additional RF filters were used on both the LT and HT lines to remove any interference from these supply lines.

The actual physical layout of a vibrator supply is also much more critical than for a mains power supply. The supply is generally shielded inside a metal box to minimise RF interference and "single-point" earthing is also often used to overcome interference problems as well. It must be remembered that a vibrator supply is a potent generator of RF interference which operated in relatively close proximity to the receiver's antenna terminal. Of course, some designs were better suppressed than others.

This view shows a 12V vibrator power supply and audio output stage, as used in an Astor DRM car radio. Note the arrow pointing to the clips holding the vibrator in place. These clips also bond the shielded vibrator case to the chassis to reduce any interference generated by the vibrator.

The vibrator supply box may also be rubber mounted – or at least the vibrator itself may be rubber mounted – so that mechanical vibrations don't cause an irritating hum or buzz. In fact, some vibrator supplies are mechanically very quiet.

The buffer

There is one other component that is vital for efficiency and long operational life from a vibrator power supply and that is the "buffer". This buffer typically consists of one or more capacitors wired across the primary and/or secondary of the vibrator power transformer. The buffer "tunes" these windings for minimum sparking at the vibrator points and for minimum current consumption by the supply when it is not supplying current to the receiver.

Without this buffer, the supply would draw very high currents and the vibrator would be destroyed within a very short time. The actual value of the capacitor(s) depends on the inductance of the transformer winding and the frequency of the vibrator's mechanical oscillation (usually either 100Hz or 150Hz).

The buffer in Astor car radios, for example, was wired across the secondary of the transformer. In later versions, this was a 0.008μF paper capacitor rated at 2000V. And no, I didn't make a mistake on the voltage rating – the transient voltages developed across the windings when the vibrator contacts open are extremely high, so a high voltage rating really was necessary.

Even so, these capacitors proved to be unreliable and when a vibrator was replaced so was the buffer, otherwise the replacement vibrator only lasted a short time. Earlier Astor car radios used a 0.004μF mica capacitor and

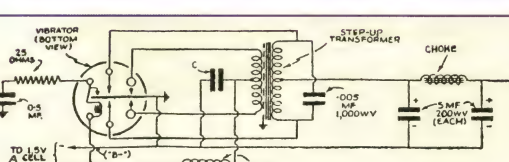


Fig.3: a 1.5V vibrator power supply circuit from the early 1940s. It was designed to provide 90V at 9mA for sets using 1.4V filament valves.

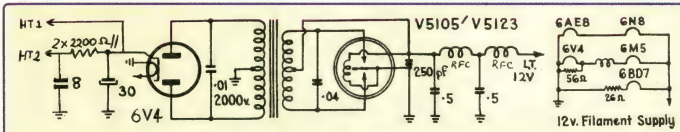


Fig.4: the Autovox Five 1955 car radio non-synchronous power supply circuit.

this was quite reliable, unlike the later 0.008µF paper capacitor.

Fig.4 shows the circuit of a non-synchronous vibrator power supply as used in a 1955 Autovox 5 car radio. It is quite similar to many other car radio power supplies.

It's worth noting that vibrators, being mechanical devices, usually didn't last as long as the other components in the set. However, it did depend very much on the actual design of the vibrator power supply and some sets had vibrator supplies that just kept on going for ever. For example, Operatic receivers had very good vibrator life, the unit rarely needing to be replaced. I also have a Radio Corporation set that has never had a vibrator replacement and it has done a lot of work.

By the way, vibrators were nominally designed for an operational life of between 1500 and 2000 hours, which equates to approximately 500-1000 million cycles of operation.

Eliminating the vibrator

A car radio can be powered by removing the vibrator and feeding low voltage AC to the heaters and around 250+ volts to the rectifier cathode. These voltages can be obtained from a 1950's era mantel receiver, providing the host receiver's valves are removed (but not the rectifier). If the car radio runs off 6V, its rectifier can be removed. However, if series parallel heater wiring is used, as in 12V sets, the rectifier needs to remain in place because its filament will be part of the heater string.

It isn't as easy to provide power to sets using battery valves. Raw AC on the valve filaments will cause the low voltage electrolytics to overheat and possibly explode, resulting in damage to the power supply and the set – so don't even think of trying this. However, it is practical to power sets from battery eliminators. These supply the HT and LT filament voltages as required. The vibrator pack can sit there with the vibrator removed, if repair is not practical.

The following voltages and current drains are typical in 6V vibrator sets. If 2V valves are used, the filament drain is 0.24A at 6V DC and the HT voltage is 135V at no more than 20mA. Alternatively, if 1.4V valves are used, the filament current will be about 0.1A at 6V DC and the HT voltage is about 90V at no more than 15mA.

A convenient way of powering the filaments is to use a small plugpack supply. Note, however, that the plugpack must be a regulated type, as the output from unregulated types rises alarmingly on light loads. The fila-

Photo Gallery: STC Model 5210/4 Dual-Wave Receiver

Towards the end of the Bakelite era, STC produced the Model 5210/4 (circa 1952) in walnut, black, off-white and possibly other colours. It was a 5-valve, dual-wave receiver and featured four large thumb knobs in a contrasting colour. The "/4" in the model number indicated a change in the rectifier type used – ie, to a 6X5-GT.

The unit is somewhat similar in line to the smaller 4-valve (broadcast-band only) model 4110 of the same year. However, the larger set doesn't quite have the same appeal.

(Restored by Maxwell L. Johnson, Tasmania; photo by Ross Johnson).

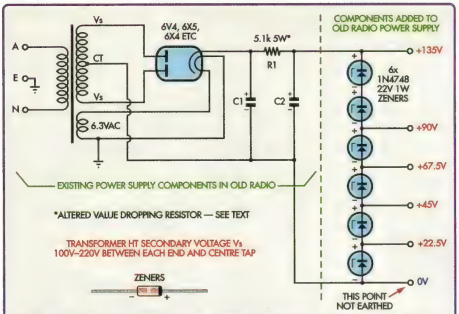


Fig.5: this diagram shows how the power supply in an otherwise derelict valve radio can be modified to provide a range of HT voltages.

ments in battery valves cannot withstand voltages more than about 20% above their ratings, so you risk burning the filaments out if they are powered from an unregulated plugpack.

Make sure the voltage applied to the filaments is 2V for a 2V valve and 1.4V for a 1.4V valve. The problem here is that regulated plugpacks only go down to 3V but that's easily overcome with some series diodes. Just install two diodes in series with the 3V supply rail from the plugpack for 2V filaments and three diodes in series for 1.4V filaments. In addition, take care with the supply polarity – the negative rail should go to earth.

Building your own

Many small power supply circuits have also been published in SILICON CHIP and some of these can be adapted to power the valve filaments in battery receivers. For example, The "Multi-Power Bench Supply" (April 2002) could be easily modified to do the job. The LM317T regulator circuit shown second from the top in the schematic diagram is the one to use – just modify the resistor values for the 3V range to get the output down to 2V.

The easiest way is to simply substitute a 1kΩ trimpot for the 680Ω resistor and adjust the pot to give the desired voltage output.

The HT voltage can be derived from a derelict valve radio power supply. Fig.5 shows how a typical valve radio power supply can be modified to provide a range of HT voltages. Make sure the supply is fully floating so that back bias can be used with battery or vibrator sets, if required.

When selecting a derelict receiver, choose one that has an output of about 250V (or preferably less) at the cathode of the rectifier when supplying around 40-50mA. The rectifier's output will rise to around 270V if the load is around 25mA, as provided by R1 and the six zener diodes in series.

When testing the supply, install a milliamp meter in series with the zener diodes and adjust the value of R1 until a current of around 20-25mA is shown on the meter. Note that the voltages shown on the terminals are approximate and depend on the current drawn and the actual characteristics of each particular zener diode. The valve rectifier can be replaced with two 1N4008 diodes if so desired but the output voltage will be higher than from a valve rectifier.

A solid state "vibrator", if available, may be the best answer for some sets. Resurrection Radio in Melbourne can supply these, as can Nostalgic Wireless. They are around $US35 which equates to around $A70-$80 landed in Australia. Old "as-new" mechanical vibrators can also be supplied at around $20 each.

Next month we'll take a closer look at vibrator power supplies and describe how to service them. SC

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August 1993: Low-Cost Colour Video Fader; 60-LED Brake Light Array; Microprocessor-Based Sidereal Clock; Satellites & Their Orbits.

September 1993: Automatic Nicad Battery Charger/Discharger; Stereo Preamplifier With IR Remote Control; Pt.1; In-Circuit Transistor Tester; +5V to +15V DC-DC Converter; Remote-Controlled Cockroach.

October 1993: Courtesy Light Switch-Off Timer For Cars; Wireless Microphone For Musicians; Stereo Preamplifier With IR Remote Control, Pt.2; Electronic Engine Management, Pt.1.

November 1993: High Efficiency Inverter For Fluorescent Tubes; Stereo Preamplifier With IR Remote Control, Pt.3; Siren Sound Generator; Engine Management, Pt.2; Experiments For Games Cards.

December 1993: Remote Controller For Garage Doors; Build A LED Stroboscope; Build A 25W Audio Amplifier Module; A 1-Chip Melody Generator; Engine Management, Pt.3; Index To Volume 6.

January 1994: 3A 40V Variable Power Supply; Solar Panel Switching Regulator; Printer Status Indicator; Mini Drill Speed Controller; Stepper Motor Controller; Active Filter Design; Engine Management, Pt.4.

February 1994: Build A 90-Second Message Recorder; 12-240VAC 200W Inverter; 0.5W Audio Amplifier; 3A 40V Adjustable Power Supply; Engine Management, Pt.5; Airbags In Cars – How They Work.

March 1994: Intelligent IR Remote Controller; 50W (LM3876) Audio Amplifier Module; Level Crossing Detector For Model Railways; Voice Activated Switch For FM Microphones; Engine Management, Pt.6.

April 1994: Sound & Lights For Model Railway Level Crossings; Discrete Dual Supply Voltage Regulator; Universal Stereo Preamplifier; Digital Water Tank Gauge; Engine Management, Pt.7.

May 1994: Fast Charger For Nicad Batteries; Induction Balance Metal Locator; Multi-Channel Infrared Remote Control; Dual Electronic Dice; Simple Servo Driver Circuits; Engine Management, Pt.8.

June 1994: A Coolant Level Alarm For Your Car; 80-Metre AM/CW Transmitter For Amateurs; Converting Phono Inputs To Line Inputs; PC-Based Nicad Battery Monitor; Engine Management, Pt.9.

July 1994: Build A 4-Bay Bow-Tie UHF TV Antenna; PreChamp 2-Transistor Preamplifier; Steam Train Whistle & Diesel Horn Simulator; 6V SLA Battery Charger; Electronic Engine Management, Pt.10.

August 1994: High-Power Dimmer For Incandescent Lights; Dual Diversity Tuner For FM Microphones, Pt.1; Nicad Zapper (For Resurrecting Nicad Batteries); Electronic Engine Management, Pt.11.

September 1994: Automatic Discharger For Nicad Batteries; Mini-Vox Voice Operated Relay; AM Radio For Weather Beacons; Dual Diversity Tuner For FM Mics, Pt.2; Electronic Engine Management, Pt.12.

October 1994: How Dolby Surround Sound Works; Dual Rail Variable Power Supply; Build A Talking Headlight Reminder; Electronic Ballast For Fluorescent Lights; Electronic Engine Management, Pt.13.

November 1994: Dry Cell Battery Rejuvenator; Novel Alphanumeric Clock; 80-Metre QSB Amateur Transmitter; Twin-Cell Nicad Discharger (See May 1993); How To Plot Patterns Direct to PC Boards.

December 1994: Easy-To-Build Car Burglar Alarm; Three-Spot Low Distortion Sinewave Oscillator; Printhead – A Pesky Electronic Cricket; Remote Control System for Models, Pt.1; Index to Vol.7.

January 1995: Sun Tracker For Solar Panels; Battery Saver For Torches; Dolby Pro-Logic Surround Sound Decoder, Pt.2; Dual Channel UHF Remote Control; Stereo Microphone Preamplifier.

February 1995: 2 x 50W Stereo Amplifier Module; Digital Effects Unit For Musicians; 6-Channel Thermometer With LCD Readout; Wide Range Electrostatic Loudspeakers, Pt.1; Oil Change Timer For Cars; Remote Control System For Models, Pt.2.

March 1995: 2 x 50W Stereo Amplifier, Pt.1; Subcarrier Decoder For FM Receivers; Wide Range Electrostatic Loudspeakers, Pt.2; IR Illuminator For CCD Cameras; Remote Control System For Models, Pt.3.

April 1995: FM Radio Trainer, Pt.1; Balanced Mic Preamp & Line Filter; 50W/Channel Stereo Amplifier, Pt.2; Wide Range Electrostatic Loudspeakers, Pt.3; 8-Channel Decoder For Radio Remote Control.

May 1995: Build A Guitar Headphone Amplifier; FM Radio Trainer, Pt.2; Transistor/Mosfet Tester For DMMs; A 16-Channel Decoder For Radio Remote Control; Introduction to Satellite TV.

June 1995: Build A Satellite TV Receiver; Train Detector For Model Railways; 1W Audio Amplifier Trainer; Low-Cost Video Security System; Multi-Channel Radio Control Transmitter For Models, Pt.1.

July 1995: Electric Fence Controller; How To Run Two Trains On A Single Track (Incl. Lights & Sound); Setting Up A Satellite TV Ground Station; Build A Reliable Door Minder.

August 1995: Fuel Injector Monitor For Cars; Gain Controlled Microphone Preamp; Audio Lab PC-Controlled Test Instrument, Pt.1; How To Identify IDE Hard Disk Drive Parameters.

September 1995: Radiosport Mk.2 Walkaround Throttle For Model Railways, Pt.1; Keypad Combination Lock; The Vader Voice; Jacob's Ladder Display; Audio Lab PC-Controlled Test Instrument, Pt.2.

October 1995: 3-Way Loudspeaker System; Railpower Mk.2 Walkaround Throttle For Model Railways, Pt.2; Build A Fast Charger For Nicad Batteries.

November 1995: Mixture Display For Fuel Injected Cars; CB Transverter For The 80M Amateur Band, Pt.1; PIR Movement Detector.

December 1995: Engine Immobiliser; 5-Band Equaliser; CB Transverter For The 80M Amateur Band, Pt.2; Subwoofer Controller; Knock Sensing In Cars; Index To Volume 8.

January 1996: Surround Sound Mixer & Decoder, Pt.1; Magnetic Card Reader; Build An Automatic Sprinkler Controller; IR Remote Control For The Railpower Mk.2; Recharging Nicad Batteries For Long Life.

April 1996: 125W Audio Amplifier Module; Knock Indicator For Leaded Petrol Engines; Multi-Channel Radio Control Transmitter; Pt.3.

May 1996: High Voltage Insulation Tester; Knightrider LED Chaser; Simple Intercom Uses Optical Cable; Cathode Ray Oscilloscopes, Pt.3.

June 1996: Stereo Simulator (uses delay chip); Rope Light Chaser; Low Ohms Tester For Your DMM; Automatic 10A Battery Charger.

July 1996: Build A VGA Digital Oscilloscope, Pt.1; Remote Control Extender For VCRs; 2A SLA Battery Charger; 3-Band Parametric Equaliser; Single Channel 8-Bit Data Logger.

August 1996: Introduction to IGBTs; Electronic Starter For Fluorescent Lamps; VGA Oscilloscope, Pt.2; 350W Amplifier Module; Masthead Amplifier For TV & FM; Cathode Ray Oscilloscopes, Pt.4.

September 1996: VGA Oscilloscope, Pt.3; IR Stereo Headphone Link.

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November 1996: 8-Channel Stereo Mixer, Pt.1; Low-Cost Fluorescent Light Inverter; Regaining Domestic Light Dimmers; Multi-Media Sound System, Pt.2; 600W DC-DC Converter For Car Hifi Systems, Pt.2.

December 1996: Active Filter Cleans Up Your CW Reception; A Fast Clock For Railway Modellers; Laser Pistol & Electronic Target; Build A Sound Level Meter; 8-Channel Stereo Mixer, Pt.2; Index to Vol.9.

January 1997: How To Network Your PC; Control Panel For Multiple Smoke Alarms, Pt.1; Build A Pink Noise Source; Computer Controlled Dual Power Supply, Pt.1; Digi-Temp Monitors Eight Temperatures.

February 1997: PC-Controlled Moving Message Display; Computer Controlled Light Dimmer; Low Noise Mic Amplifier; Low Cost Recording Telephone Alarm; Control Panel For Multiple Smoke Alarms, Pt.2.

March 1997: Driving A Computer By Remote Control; Plastic Power PA Amplifier (175W); Signalling & Lighting For Model Railways; Build A Jumbo LED Cube; Digital Oscilloscopes, Part 1.

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May 1997: Neon Tube Modulator For Light Systems; Traffic Lights For A Model Intersection; The Soapmaster – It Writes Messages In Thin Air; A Look At Signal Tracing; Pt.2; Cathode Ray Oscilloscopes, Pt.9.

June 1997: PC-controlled Thermometer/Thermostat; TV Pattern Generator, Pt.1; Audio/RF Signal Tracer; High-Current Speed Controller For 12V/24V Motors; Manual Winder For Model Railway Points, Pt.2

July 1997: Infrared Remote Volume Control; A Flexible Interface Card For PCs; Points Controller For Model Railways; Colour TV Pattern Generator, Pt.2; An In-Line Mixer For Radio Control Receivers.

August 1997: The Bass Barrel Subwoofer; 500 Watt Audio Power Amplifier Module; Mini Sound Effects Unit; Interface Software For PC Card For Stepper Motor Control; Remote Controlled Gates For Your Home.

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October 1997: Build A 5-Digit Tachometer; Add Central Locking To Your Car; PC-Controlled 8-Channel Voltmeter; 500W Audio Power Amplifier, Pt.3; Customising The Windows 95 Start Menu.

November 1997: Heavy Duty 10A 240VAC Motor Speed Controller; Easy-To-Use Guitar & Wiring Tester; Build A Musical Doorbell; Repairing Foam Speaker Surrounds; Understanding Electric Lighting Pt.1.

December 1997: Speed Alarm For Cars; 2-Axis Robot With Gripper; Stepper Motor Driver With Onboard Buffer; Power Supply For Stepper Motor Cards; Understanding Electric Lighting Pt.2; Index to Vol.10.

January 1998: Build Your Own 4-Channel Lightshow, Pt.1 (runs off 12VDC or 12VAC); Command Control System For Model Railways, Pt.1; Pan Controller For CCD Cameras.

February 1998: Multi-Purpose Fast Battery Charger, Pt.1; Telephone Exchange Simulator For Testing; Command Control System For Model Railways, Pt.2; Build Your Own 4-Channel Lightshow, Pt.2.

April 1998: Automatic Garage Door Opener, Pt.1; 40V 8A Adjustable Power Supply, Pt.1; PC-Controlled 0-30kHz Sinewave Generator; Build A Laser Light Show; Understanding Electric Lighting, Pt.3.

May 1998: Troubleshooting Your PC, Pt.1; Build A 3-LED Logic Probe; Automatic Garage Door Opener, Pt.2; Command Control For Model Railways, Pt.4; 40V 8A Adjustable Power Supply, Pt.2.

June 1998: Troubleshooting Your PC, Pt.2; Universal High Energy Ignition System; The Roadrail Train Controller, Pt.1; Unipolar Stepper Motor Controller; Command Control For Model Railways, Pt.5.

July 1998: Troubleshooting Your PC, Pt.3; 15W/Ch Class-A Audio Amplifier, Pt.1; Simple Charger For 6V & 12V SLA Batteries; Automatic Semiconductor Analyser; Understanding Electric Lighting, Pt.8.

August 1998: Troubleshooting Your PC, Pt.4 (Adding Extra Memory); Simple I/O Card With Automatic Data Logging; Build A Beat Triggered Strobe; 15W/Ch Class-A Stereo Amplifier, Pt.2.

September 1998: Troubleshooting Your PC, Pt.5; A Blocked Air-Filter Alarm; Wax-Wax Pedal For Dazzling Dancers; Loader, Gear Change Indicator For Cars; Capacity Indicator For Rechargeable Batteries.

October 1998: AC Millivoltmeter, Pt.1; PC-Controlled Stress-O-Meter; Versatile Electronic Guitar Limiter; 12V Trickle Charger For Float Cookers; Adding An Extension Pack To Your Fridge/Freezer.

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January 1999: High-Voltage Megohm Tester; Getting Started With BASIC Stamp; LED Bargraph Ammeter For Cars; Keypad Engine Immobiliser; Improving AM Radio Reception, Pt.3.

March 1999: Getting Started With Linux; Pt.1; Build A Digital Anemometer; Simple DIY PIC Programmer; Easy-To-Build Audio Compressor; Low Distortion Audio Signal Generator, Pt.2.

April 1999: Getting Started With Linux; Pt.2; High-Power Electric Fence Controller; Bass Cube Subwoofer; Programmable Thermostat/ Thermometer; Build An Infrared Sentry; Rev Limiter For Cars.

May 1999: The Line Dancer Robot; An X-Y Table With Stepper Motor Control, Pt.1; Three Electric Fence Testers; Heart Of LEDs; Build A Cartoon Moonwalk Alarm; Getting Started With Linux; Pt.3.

June 1999: FM Radio Tuner Card For PCs; X-Y Table With Stepper Motor Control, Pt.2; Programmable Ignition Timing Module For Cars, Pt.1; Hard Disk Drive Upgrades Without Reinstalling Software?

July 1999: Build A Dog Silencer; 10µH to 19.999mH Inductance Meter; Build An Audio Video Transmitter; Programmable Ignition Timing Module For Cars, Pt.2; XYZ Table With Stepper Motor Control, Pt.3.

August 1999: Remote Modem Controller; Daytime Running Lights For Cars; Build A PC Monitor Checker; Switching Temperature Controller; XYZ Table With Stepper Motor Control, Pt.4; Ignition Lighting, Pt.14.

September 1999: Autonomouse The Robot, Pt.1; Voice Direct Speech Recognition Module; Digital Electrolytic Capacitance Meter; XYZ Table With Stepper Motor Control, Pt.5; Peltier-Powered Can Cooler.

October 1999: Build The Railpower Model Train Controller, Pt.1; Semiconductor Curve Tracer; Autonomouse The Robot, Pt.2; XYZ Table With Stepper Motor Control, Pt.6; Introducing Home Theatre.

November 1999: Setting Up An Email Server; Speed Alarm For Cars, Pt.1; LED Christmas Tree; Intercom Station Expander; Foldback Loudspeaker System; Railpower Model Train Controller, Pt.2.

December 1999: Solar Panel Regulator; PC Powerhouse (gives +12V, +9V, +6V & +5V rails); Fortune Finder Metal Locator; Speed Alarm For Cars, Pt.2; Railpower Model Train Controller, Pt.3; Index To Vol.12.

January 2000: Spring Reverberation Module; An Audio-Video Test Generator; Build The Nelson Programmable Timer; A Parallel Port Interface Card; Off-Hook Indicator For Telephone Lines.

February 2000: Multi-Sector Sprinkler Controller; A Digital Voltmeter For Your Car; An Ultrasonic Parking Radar; Build A Safety Switch Checker; Build A Sine/Square Wave Oscillator.

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May 2000: Ultra-LD Stereo Amplifier, Pt.2; Build A LED Dice (With PIC Microcontroller); Low-Cost PC Serial Port (Converts IBM Scan-Codes To ASCII); 50A Motor Speed Controller For Models.

June 2000: Automatic Rain Gauge With Digital Readout; Parallel Port VHF FM Receiver; Li'l Powerhouse Switchmode Power Supply (1.23V to 40V) Pt.1; CD Compressor For Car Stereos, Pt.1.

July 2000: A Moving Message Display; Compact Fluorescent Lamp Driver; El-Cheapo Musician's Lead Tester; Li'l Powerhouse Switchmode Power Supply (1.23V to 40V) Pt.2.

August 2000: Build A Theremin For Really Eerie Sounds; Computer Controlled Stepper Motor Driver; Proximity Switch For 240VAC Lamps; Structured Cabling For Computer Networks.

September 2000: Build A Swimming Pool Alarm; An 8-Channel PC Relay Board; Fuel Mixture Display For Cars, Pt.1; Protoboards – The Easy Way Into Electronics, Pt.1; Cybug The Solar Toy.

October 2000: Guitar Jammer For Practice & Jam Sessions; Boost Tester Breaker Tester; A Wind-Mounted Video Camera; Installing A Free-Air Subwoofer In Your Car; Fuel Mixture Display For Cars, Pt.2.

November 2000: Santa & Rudolf Christie Display; 2-Channel Guitar Preamplifier, Pt.1; Message Bank & Missed Call Alert; Protoboards – The Easy Way Into Electronics, Pt.3.

December 2000: Home Networking For Shared Internet Access; Build A Bright-White LED Torch; 2-Channel Guitar Preamplifier, Pt.2 (Digital Reverb); Driving An LCD From The Parallel Port; Index To Vol.13.

January 2001: How To Transfer LPs Or Tapes To CD; The LP Doctor – Clean Up Clicks & Pops; Analogue Waveform Generator; 2-Channel Guitar Preamplifier, Pt.3; PIC Programmer & TestBed.

February 2001: An Easy Way To Make PC Boards; Li'l Pulser Train Controller; A MIDI Interface For PCs; Build The Bass Blaster; 2-Metre Groundplane Antenna; The LP Doctor – Clean Up Clicks & Pops, Pt.2.

March 2001: Making Photo Resist PC Boards; Big-Digit 12/24 Hour Clock; Parallel Port PIC Programmer & Checkerboard; Protoboards – The Easy Way Into Electronics, Pt.5; A Simple MIDI Expansion Box.

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May 2001: Powerful 12V Mini-Stereo Amplifier; Two White-LED Torches To Build; HomePak – A Multi-Voltage Power Supply; Using Linux To Share An Internet Connection, Pt.1; Tweaking Windows With TweakUI.

June 2001: Fast Universal Battery Charger, Pt.1; Phonome – Call, Listen In & Switch Devices On & Off; LY Snooper – A Low-Cost Automatic Camera Switcher; Using Linux To Share An Internet Connection, Pt.2; A PC To Die For, Pt.1 (Building Your Own PC).

July 2001: The HeartMate Heart Rate Monitor; Do Not Disturb Telephone Timer; Pic-Toc – A Simple Alarm Clock; Fast Universal Battery Charger, Pt.2; A PC To Die For, Pt.2; Backing Up Your Email.

August 2001: DI Box For Musicians; 200W Mosfet Amplifier Module; Headlight Reminder; 40MHz 6-Digit Frequency Counter Module; A PC To Die For, Pt.3; Using Linux To Share An Internet Connection, Pt.3.

September 2001: Making MP3s – Rippers & Encoders; Build Your Own MP3 Jukebox, Pt.1; PC-Controlled Mains Switch; Personal Noise Source For Tinnitus Sufferers; The Sooper Sooper Directional Microphone, Using Linux To Share An Internet Connection, Pt.4.

November 2001: Ultra-LD 100W RMS/Channel Stereo Amplifier, Pt.1; Neon Tube Modulator For Cars; Low-Cost Audio/Video Distribution Amplifier; Short Message Recorder Player; Computer Tips.

December 2001: A Look At Windows XP; Build A PC Infrared Transceiver; Ultra-LD 100W RMS/Ch Stereo Amplifier, Pt.2; Parcy Lights – An Intriguing Christmas Display; PC Fun – Learning About Windows.

January 2002: Touch And/Or Remote-Controlled Light Dimmer, Pt.1; A Cheap 'n'Easy Motorbike Alarm; 100W RMS/Channel Stereo Amplifier, Pt.3; Build A Raucous Alarm, PABs On The MP3 Jukebox.

February 2002: 10-Channel IR Remote Control Receiver; 2.4GHz High-Power Video Transmitter; Customise Your Own 3-Way Tower Speakers; Touch And/Or Remote-Controlled Light Dimmer, Pt.2; Booting A PC Without A Keyboard; 4-Way Event Timer.

March 2002: Mighty Midget Audio Amplifier Module; The Itsy-Bitsy USB Lamp; 8-Channel IR Remote Volume Control, Pt.1; RIAA Pre-Amplifier For Magnetic Cartridges; 12/24V Intelligent Solar Power Battery Charger; Generate Audio Tones Using Your PC's Soundcard.

April 2002: Automatic Single-Channel Light Dimmer, Pt.1; Build A Water Level Indicator; Multiple-Output Bench Power Supply; Versatile Multi-Mode Timer; 8-Channel IR Remote Volume Control, Pt.2.

May 2002: 32-LED Knightrider; The Battery Guardian (Cuts Power When the Battery Voltage Drops); Stereo Headphone Amplifier; Automatic Single-Channel Light Dimmer, Pt.2; Stepper Motor Controller.

June 2002: Lock Out The Bad Guys with A Firewall; Remote Volume Control For Stereo Amplifiers; The "Matchless" Metal Locator; Compact 0-80A Automotive Ammmeter; Constant High-Current Source.

July 2002: Telephone Headset Adaptor; Rolling Code 4-Channel UHF Remote Control; Remote Volume Control For The Ultra-LD Stereo Amplifier; Direct Conversion Receiver For Radio Amateurs, Pt.1.

August 2002: Digital Instrumentation Software For Your PC; Digital Storage Logic Probe; Digital Thermometer/Thermostat; Sound Card Interface For PC Test Instruments; Direct Conversion Receiver For Radio Amateurs, Pt.2; Spruce Up Your PC With XP-Style Icons.

September 2002: 12V Fluorescent Lamp Inverter; 8-Channel Infrared Remote Control; Dual DC Electronic Load; Driving Light & Accessory Protector For Cars; Spyware – An Update.

October 2002: Speed Controller For Universal Motors; PC Parallel Port Wizard; "Whistle & Point" Cable Tracer; Build An AVR ISP Serial Programmer; Watch Out For Trojans In Your Own Home.

November 2002: SuperCharger For NiCd/NiMH Batteries, Pt.1: Windows-Based EPROM Programmer, Pt.1; 4-Digit Crystal-Controlled Timing Module; Using Linux To Share An Optus Cable Modem, Pt.1.

December 2002: Receiving TV From Satellites, Pt.1; The Microcontroller Stereo FM Transmitter; Windows-Based EPROM Programmer, Pt.2; SuperCharger For NiCd/NiMH Batteries, Pt.2; Simple VHF FM/AM Radio; Using Linux To Share An Optus Cable Modem, Pt.2.

January 2003: Receiving TV From Satellites, Pt.2; SC480 50W RMS Amplifier Module, Pt.1; Digital Voltmeter For Cars; Active 3-Way Crossover For Speakers; Using Linux To Share An Optus Cable Modem, Pt.3.

February 2003: The PortaPal Public Address System, Pt.1; 240V Mains Filter For HiFi Systems; SC480 50W RMS Amplifier Module, Pt.2; Windows-Based EPROM Programmer, Pt.3; Using Linux To Share An Optus Cable Modem, Pt.4; Tracking Down Elusive PC Faults.

March 2003: LED Lighting For Your Car; Peltier-Effect Tinnie Cooler; PortaPal Public Address System, Pt.2; 12V SLA Battery Float Charger; Build The Little Dipper Metronome; Subwoofer: Fun With The PICAXE (Build A Shop Door Minder); SuperCharger Addendum; Emergency Beacons.

April 2003: Video-Audio Booster For Home Theatre Systems; A Highly-Flexible Keypad Alarm; Telephone Dialler For Burglar Alarms; Three Do-It-Yourself PIC Programmer Kits; More Fun With The PICAXE; Pt.3 (Heartbeat Simulator); Electric Shutter Release For Cameras.

May 2003: Widgibox Guitar Distortion Effects Unit; 10MHz Direct Digital Synthesis Function Generator; Subwoofer: Fun With The PICAXE, Pt.4; More Fun With The PICAXE, Pt.4 (Motor Controller).

June 2003: More Fun With The PICAXE, Pt.5; PICAXE-Controlled Telephone Intercom; PICAXE-08 Port Expansion; Sunset Switch For Security & Garden Lighting; Digital Reaction Timer; Adaptable DC-DC Converter For Cars; Long-Range 4-Channel UHF Remote Control.

July 2003: Smart Card Reader & Programmer; Power-Up Auto Mains Switch; A "Smart" Stove Flash Trigger; Programmable Continuity Tester; PICAXE Pt.6 – Data Communications; Updating The PIC Programmer & Checkerboard; RFID Tags – How They Work.

August 2003: PC Infrared Remote Receiver (Play DVDs & MP3s On Your PC Via Remote Control); Digital Instrument Display For Cars, Pt.1; Home-Brew Weatherport 2.4GHz WiFi Antennas; PICAXE Pt.7 – Get That Clever Code Purring; A Digital Timer For Less Than $20.

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Reflector for LED torch

I would like to build my own version of the 6-LED torch from the May 2001 issue of SILICON CHIP. I would be using a single "D" size Nicad and manufacturing my own robust aluminium housing on my lathe. However, is it really necessary to use a torch type reflector? From my experience a LED throws most of its light forward. Or is it because they use these reflectors for the convenience of having a battery case and switch, etc? (R. G., via email).

● There is no real need to use a reflector in the LED torch.

Speed control for ceiling fan

I have a ceiling fan with a 3-speed controller. Lately the fan has started to run more slowly on the slowest speed than it did previously. I have often wondered how these beasts work. The controller seems to consist of a switch embedded in an epoxy block and it doesn't really seem to get very hot so how does it dissipate the energy on the slower speeds ? Even if it has more than four poles, there are only two wires going to the fan, precluding some sort of pole-switching arrangement. (I. L., via email).

● It seems highly likely that your existing speed controller is a tapped inductor. In the January 1990 issue we showed how to use a Triac light dimmer in series with one of the taps on the inductor to achieve a much better and wider speed control. The dimmer board used then is no longer available but you could use the same approach with a standard light dimmer with snubber components (50µH choke and .01µF 250VAC capacitor) added as shown in the speed control circuit. We can supply the January 1990 issue for $8.80 including postage.

Tuning the Theremin

I've assembled a Theremin kit from Jaycar Electronics (based on your August 2000 article) and have run into a little difficulty. I followed the tuning instructions in the directions. The telescoping antenna, which is supposed to control the pitch, appears to have no effect, regardless of how T2 is tuned.

While experimenting with tuning the four transformers, I found in some cases the volume plate affects the pitch, but it appears to be tuned properly at present to affect only the volume. I inspected the PC board and found no obvious soldering flaws. The plate is wired to the hole on the left side of the PC board and the antenna to the upper-right, as shown in Fig. 5.

Would you please give me some pointers on what I should look for? (D. B., via email).

● The voltages on each FET should be checked first. Connect a multimeter to ground (0V) and measure the voltage at the drain terminals of Q1, Q2 and Q3. These should all be similar.

Alignment may require that coil T1 be adjusted first to some position for the slug, with the remaining coils readjusted for best results.

Problems may occur if a plugpack which uses a centre tapped transformer is used. Check that this is not the problem by powering temporarily using a 9V or 12V battery or power supply that is not earthed to the negative terminal.

Preamp for DVD player

I find that the analog audio outputs from my DVD player are significantly lower than from the VCR. The "normal" audio setting on my TV is about 15 but I need to crank this up to 35 sometimes on DVD. It may be a peculiarity of my DVD player and furthermore, not all DVD discs have the same volume level.

No amount of fiddling with DVD menus fixes this problem. I even took the lid off to look for some audio level presets but none are available.

What I need is a simple stereo line amplifier, with adjustable gain and a stereo LED bargraph VU meter to show the level coming out of this amplifier. I could knock one up using a couple of low-noise op amps and LM3914 bargraph chips but a nicely designed project with PC boards would be great. (P. K., via email).

● You have two choices for a preamp with level meter. You can build the preamplifier from the Ultra-LD amplifier described in the November & December 2001 issues (you'll need both issues) or you can build the later remote motorised volume control version published in June & July 2002.

We can supply these issues for $8.80 each, including postage.

Improving precision rectifier response

I am wishing to use the precision rectifier circuit from the Sound Level Meter (SILICON CHIP, December 1996) in another project and I am hoping you may be able to advise me as follows (I also noted the precision rectifier circuit used in the AC Millivoltmeter project from the October 1998 issue). For my application, the signal level feeding the rectifier will be anywhere from zero up to a maximum of 150mV RMS, within a frequency range of 10Hz to 100kHz.

I have bread-boarded the December 1996 precision rectifier circuit but found that it doesn't operate with a ruler flat response to 100kHz (I expect it was never designed for that!).

Are there changes I could make to the December 1996 precision rectifier circuit to optimise its operation for my specific AC voltage levels? Can I obtain a positive output from the (two-stage) rectifier instead of a negative output? If so, what changes should I make to achieve this? (G. D., via email).

● The precision rectifier will work best at 100kHz if the resistor values are reduced. Use 1kΩ instead of the 10kΩ and 2kΩ instead of the 20kΩ resistors. The arrangement is an inverting style.

To obtain a positive output, add another op amp inverter like the second stage with two 1kΩ resistors – one between the inverting input and the output, and the signal applied to the other 1kΩ resistor which is also connected to the inverting input.

Moving message LED displays

Could you please tell me the back issues where there were articles on how to build alphanumeric LED displays and the techniques of scrolling text from right to left without any tailing effect in the moving text. (D. T., via email).

● We have published three moving LED message displays, in July 2000, February 1997 and March to June 1989. If you want to understand the circuit techniques, have a look at the articles in February 1997 and March and April 1989. We can supply copies of these articles for $8.80 each, including postage.

Dimming halogen lights

I have used a touch/dimmer switch with the intention of controlling a 105W halogen light transformer (Jaycar Cat. MP-3054) and I am getting a flickering light. Is there anything I can do to rectify this problem? The touch/dimmer switch works fine on other incandescent lights. (L. C., via email).

● Generally, light dimmers require a snubber across the Triac A1 to A2 terminals to prevent flickering when driving an inductive load such as a transformer. You could try using a 1kΩ 1W resistor in series with a 100nF 250VAC (class X2) capacitor across the Triac terminals.

However, we note that the 105W unit you are using is a switchmode device which may cause problems with a dimmer (even though it is stated as being suitable for dimming).

Induction motor controller wanted

Back in November 1997, SILICON CHIP put out a Universal Speed Controller. However, I need to control a bench grinder with a 2-pole 2850 RPM induction motor. I was hoping you could help by doing a similar unit. I use the grinder to polish polypropylene at low and high speed, so I need good speed regulation under load. Have you considered such a project or would you consider one? (M. P., South Caulfield, Vic).

● We have no plans to produce an induction motor controller. The design is much more complex as the circuit needs to control both the frequency and the voltage. It also needs to cope with high start-up currents. Sorry.

Large seconds for Big Digit Clock

Is it possible to modify the Big Digit Clock circuit (SILICON CHIP, March 2001) so that the seconds display uses the large LED displays (ignoring the changes to the PC board). Would it simply be a matter of changing the values of the 220Ω resistors? (M. H., via email).

● Large seconds displays can be driven in the same way as the other large displays. Just change the resistors as you suggest.

Increasing the rating of the Battery Guardian

My application for the Battery Guardian (SILICON CHIP, May 2002 is to look after the auxiliary battery in my caravan when running an Electrolux RM2510 refrigerator. This can run on 12V, 240VAC and gas and is operated from 12V while towing. When we are camped, the fridge is either on 240VAC from a caravan park supply or on gas from our bottles.

I have discovered that the RM2510's 12V operating current is 14.6A. As it is an absorption unit (common to all caravan fridges), this current does not change between start-up and normal running. However, the Battery Guardian's specified maximum current is 10A. By the same token, I have noted that the specified Mosfet (Q1) seems to be a 60A unit.

What do I need to do to be able to use the Guardian with my fridge in 12V mode when towing? G. B., via email).

● The answer is to use a bigger fuse. You will need to bypass the existing

Alarm Dialler Won't Dial

I have built the Alarm Dialler project from the April 2003 issue of SILICON CHIP and I am using an "Atlantis 1456 vqe" external modem (the computer recognises it as an Askey 56k voice modem).

The Dialler tests fine when connected to the computer via a 15-pin serial cable (female both ends, with the cross over). However, the modem only likes to dial when forced to by the computer; ie, under HyperTerminal, it will ring any number you like. When the string "AT&K0S0=0&D0S7=20V0E0&W" is entered to the modem, all seems normal. Then if you connect the dialler to the modem and bring up an alarm, the modem brings up dial tone but will not dial the number.

It seems that I may require another piece of code to enter in the modem so that it won't wait for the dial tone. I have tried increasing and decreasing the "s7=*". What should I try next? (S. C., via email).

● It appears that everything is working, except that the modem will not dial out. This may be because the modem is configured to look for dial tone before dialling and even though dial tone is present, the modem does not recognise it. This is not an uncommon problem.

To get around this, you need to set the modem to ignore dial tone when going on line to dial. The most likely command is ATX0. If this doesn't work, try ATX1 or ATX2. Remember to end with &W to write the new parameter.

Chirps for a Ford AU Falcon

In answer to MD's question regarding the Ford AU audible car lock (July 2003), here is an extract from the "Security Pamphlet" (Rev 1 of 2/00) issued when these vehicles were new. It is assumed the vehicle has the integrated alarm.

"Arm/disarm" chirps can be turned on or off using the following procedure: (a) Turn the siren key to the "Test" position. The siren will emit two chirps; (b) Turn the ignition key to the "ON" position and watch the indicators; (c) On the seventh flash of the indicators, turn the ignition "OFF" (the siren will emit seven confirmation chirps); (d) Turning the ignition ON-OFF will toggle the selection – one chirp indicates chirps have been selected "OFF", two chirps indicate chirps have been selected "ON"; (e) Return the siren key to the "ON" position to lock in the selection.

I have an AUII Fairmont and just after I bought it brand new I had a warranty problem with the alarm system that caused me to seek advice from the alarm manufacturer "Vision Automotive Technology". They were more than happy to help me out with my problem. (P. J., Dubbo, NSW).

fuseholder on the PC board and use an in-line fuseholder with a 20A fuse. This will need to be a 5AG or blade fuse type (available from Jaycar).

Compensating for industrial deafness

Along with many others, I suffer from industrial deafness; not too bad but enough to be a nuisance to me and my family. The usual characteristic is a loss of hearing at 2kHz and 4kHz - the so-called "2k and 4k notch". The 2kHz notch is unfortunately right in the range of sounds that characterise so much speech and so make it difficult to pick out words.

What is required is an amplifier which can be attached to the TV set speaker wires to correct for these frequencies and then feed it to the speakers. I am told by an audiologist that it is unlikely that other listeners would notice it much and it would mean that we can run the TV at lower volume.

Another option would be an appropriate amplifier to feed signals to an FM transmitting headphone set. I have a set of these and they save the volume problem for everyone else but are a nuisance. (R. C., Parkdale, Vic).

● Your audiologist is wrong. Boosting the midrange sufficiently for you to hear it will make the sound quite unpleasant for others. Your FM headset is the better solution.

Li'l Pulser Train Controller.

I have just completed the Li'l Pulser Train Controller and find that the output drive starts at about half scale. When the speed control is set down low, there are "bursts" of output. What could be the problem? (B. S., Conder, ACT).

● The controller requires a motor to be used as a load so that the speed can be controlled. If you are using a different load, it will cause problems.

Check the orientation of diodes D4 & D5 and the components around IC1a and IC1b. Make sure that the trimmer potentiometers are installed in their correct place and that the 12V is going to IC1 and IC2.

Using the Mixture Meter with old engines

I have built the Fuel Mixture Meter from the September 2000 issue but I was going to use it on an older pre-unleaded engine (1972 vintage car). I realise that the EGO sensor would be adversely effected by the tetraethyl lead additives that were used but what about the newer fuels; ie, the super lead-substitute fuels that do not necessarily use lead additives?

Can these newer fuels, that are specifically designed for pre-unleaded vehicle engines, be used longer term with the zirconia sensors or is it only short term as described? (R. Z., via email).

● Just use LRP (lead replacement petrol) and it will work fine.

Preamp for neon tube modulator

I was wondering how I could incorporate a microphone input into the Neon Tube Sound Display project (SILICON CHIP, November 2001)? Would I need to add an amplifier, preamp or anything like that?

The type of microphone would probably be a standard electret microphone. (A. H., via email).

● Have a look at the PreChamp project, described in the July 1994 issue.

Notes & Errata

PC Infrared Remote Receiver, August 2003: the parts list the PC board size as 100.5mm x 117mm. It should be 47mm x 59mm.

WARNING!

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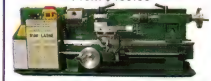
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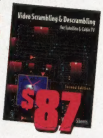

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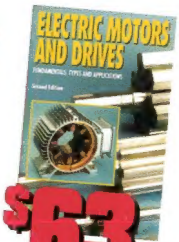

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